WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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WORK WORLD.

AN electric tricycle has been invented that will carry three persons one hundred miles for one shilling. This is the electrical expense—no other!

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Pahang mahogany is recommended to amateurs as being easy to work and free from knots. It has little or no figure, but can be used for many purposes. It is cheaper than mahogany, being about 6d. to 7d. per foot super.

* *

A Birmingham bicycle maker has patented a new form of crank which is reported to be a good thing. It is of the detachable variety. The improvement consists in the cutter pin—usually driven tight—being actuated by a screw, no hammering proving necessary for the driving out process.

* *

A new lamp for burning either petroleum or tar oil as required has been introduced. The burner is made of steel, and has no tubes to become filled with deposit from combustion, thus obviating one of the great drawbacks in other lamps. They are made in sizes varying from 500 to 2,000 candle-power.

* *

In high-class French clocks all the ornamental parts are being hand engraved instead of the pressed and chased ornament which has hitherto prevailed. This Paris lead in ornamental work and decoration for clocks should be the advent of a good time for the long-suffering ornamental engravers of London, Birmingham, and Sheffield.

* *

We shall probably soon be in a position to prove the maximum size of gas engine which can be worked economically. A maker has recently completed an engine to develop 60 h.-p., and this has been considered by many to be near the limit of efficiency of this type of engine. Further experiments in this direction will be awaited with interest.

* *

A new invention for the prevention of the bursting of water pipes through freezing seems to be simple. It consists of the insertion into the pipes, at suitable places, of a slender rod of prepared cork encased in thin lead. The cork is compressed by the expansion of the water in freezing, thus saving the strain on the pipes.

* *

Readers of WORK should be well represented at the exhibition of swords, bayonets, shields, repoussé, chasing, and all kinds of metal work to be held next week by the Armourers' and Braziers' Company at their hall, Coleman Street, London. There is a rich prize design to be furnished for the certificate in connection with the awards, so that ample scope has been afforded by the Company for rising merit.

* *

A well-known Tyne shipbuilder gave recently some extraordinary figures relating to the bye-products obtained from smoke. The total cost of the fuel exerted was £31, while the value of sulphate of ammonia obtained from the smoke arising from it was £48! Such a result should induce plodding coal consumers not only to husband their own smoke, but turn it at the same time to a similar profitable account.

* *

In the crucible steel trade of St. Petersburg, the wages of the workmen in each shift are as follows:—Head-furnace man, 4s. 9½d. per shift; crucible drawers, 3s. 2½d.; muffle-furnace man, 2s.; head man at gas-producer, 2s. 3½d.; fireman, 2s. As the wages are paid in paper money, their purchasing power is, of course, less than that represented by the nominal equivalent in currency.

* *

American railway managers are now working hard to realise, in time for the opening of the Chicago Exhibition, their dream of running a train from New York to that city in sixteen or seventeen hours. With regard to the increased risk of accident from greater speed, managers are inclined to the belief that the faster a train ran, the more likely would it be to derail any impediment on the track. This our "cousins" will doubtless prove in the Exposition season.

* *

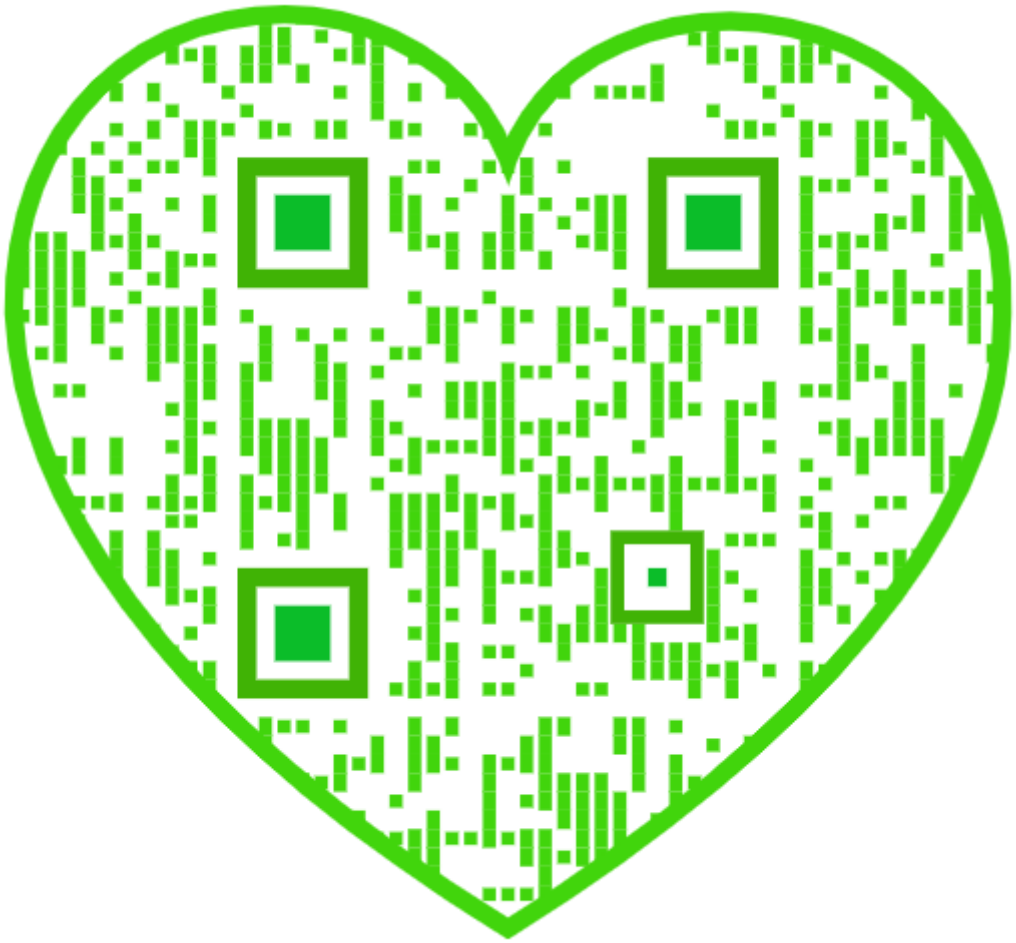
Active measures are now being taken for the establishment of an Engineering Exchange in London, and a provisional committee has been appointed to make arrangements for the erection of the necessary buildings. It is somewhat astonishing that we have gone on so long without such accommodation when the magnitude of the business done in London in this direction is considered, for not only are there upwards of 1,000 constructive firms in and about the metropolis, but nearly all the large provincial firms have their representatives in the City or in Westminster.

* *

It is claimed that an automatic condenser for steam engines has been invented, but so far we have obtained no satisfactory account of its practical outcome. The most striking characteristic of this apparatus is that it is asserted to be self-acting; there is no cold water to be used, the steam in some mysterious way condenses itself on coming into contact with a closed cycle current of *hot* water. Of course, if this is the case, all the condensation water will be saved, and we shall look forward with interest to see so desirable an end attained. In the meantime, it is startling to hear of steam being condensed by interaction with a small quantity of hot water. Still, we are open to conviction.

* *

Since fancy stones—that is, the more uncommon varieties of sapphires, jargoons, etc.—have been in request, there has been a pretty sharp look-out for uncommon gems. Now to those interested in such matters, the place where a new gem can be seen may prove worth noting. It is at the Museum of Practical Geology, in Jermyn Street, W., and the stone is called a beryllonite; it is an American gem like the hiddenite, but does not possess the beautiful colours of that gem. The new gem is white, and is interesting to connoisseurs on account of its composition, which is an anhydrous phosphate of beryllium and sodium. To judge by its appearance at night, it will not supplant any of our old gems. Should any jeweller have one to set, he must exercise care, as it very easily splits. It is, in fact, as quickly damaged as a sphene, and that is saying something. These two stones are good examples of cleavage—in fact, too good for those that have to set them.



An aluminium launch, the motor of which is a naphtha engine, has been constructed by a German firm. Only the hull is of aluminium; yet this makes the boat 35 per cent. lighter than usual. The exterior is polished, and the smoothness gives a considerably greater speed than could be obtained from a steel or wooden launch of the same dimensions and engine power.

* *

It is proposed to substitute an electro-magnetic hammer for the ordinary steam hammer. The piston is of magnetic material, and the cylinder is composed of a series of coils, through each of which an electric current may be passed separately. The passage of an electric current through the coils forming the upper part of the cylinder raises the piston into the magnetic field thus formed, and by cutting off the current, and simultaneously transferring it to the lower coils of the cylinder, the piston is released, its fall being accelerated by the magnetic attraction created below.

* *

Electric welding, invented by Professor Elihu Thomson, in 1886, is now a rapidly developing industry. All kinds of metals and alloys can be joined electrically, and joints can be made between metals and alloys of dissimilar kinds. The process consists essentially in applying the two pieces of metal to be welded together, and passing a strong alternating current through the juncture, when the intense heat, due to the electrical resistance at the break, which is greater than at any other part of the conductor, fuses the surfaces. At the instant of welding, it is found best to exert considerable pressure upon the joint, ranging from 600 lbs. per square inch in the case of copper, to 1,800 lbs. per square inch in that of steel. This process is likely soon to find vent in the direction of a new carriage, cab, and cart wheel, which should work wonders in the wheelwrighting trades. The system was privately exhibited in Birmingham recently, when a number of gentlemen connected with the cycle and kindred trades had an opportunity of witnessing the operation. It cannot fail to be of vast service in cycle building and other trades where small weldings and a large amount of brazing are required.

PRINTING ON BROMIDE PAPER.

BY G. P.

INTRODUCTORY—ARTISTIC QUALITIES OF BROMIDE PAPER—THE METHOD—WHERE TO PROCURE THE PAPER—EXPOSING THE PAPER.

Introductory.—It is a common complaint amongst amateur photographers, particularly those who are engaged most of the day and have only a few hours in the evening which they can devote to their hobby, that some of the processes connected with the production of a finished print are too protracted—some say "tedious." This objection may, in all its entirety, be urged against the process of silver printing. Silver printing may be said to date as far back as 1777, when photography was an unknown art. In that year Scheele, the celebrated chemist, discovered that chloride of silver blackened when exposed to light. In 1802 Thomas Wedgwood described a process of making profiles by its agency, and in 1839 Fox Talbot announced to the Royal Society a method of "Photogenic Drawing," in which pictures were produced upon paper prepared with the compound. Since then silver printing paper has advanced but little towards perfection, and, although it is perhaps most used in the present day, it is lacking in many ways. Shortly after the revolution in the photographic world caused by the advent of gelatine plates, a firm of manufacturers introduced a printing paper coated with an emulsion of bromide of silver in gelatine. This paper, known as "bromide paper," has many qualities to commend it, not the least of which is the rapidity with which the whole process may be completed. Some people aver that they can turn out thirty bromide prints in one hour. It is better not to be in quite such a hurry, however. Again, the process may be worked by artificial light, and will therefore commend itself to those who, being engaged most of the day, have generally only a few hours in the evening to spare for attention to photographic pursuits.

Artistic Qualities of Bromide Paper.—Dr. P. H. Emerson condemns bromide paper as "false in tonality, the blacks being too black, and the whole picture lowered in tone"; and there can be no doubt that when worked according to the crude formulæ sent out by the makers, its range is comparatively limited. On the other hand, Mr. Andrew Pringle maintains that "the most expert judge cannot at all times distinguish between a platinum print of good quality and a bromide print, provided he cannot manipulate the surface or scrutinise it in an unusual way—in other words, provided the prints are framed." The facts seem to be that bromide printing has never had fair justice done to it by the makers, who send it out with vague and unscientific instructions for use; for the fine prints of lake scenery by Green, of Keswick, show of what good results the bromide process is capable. Now, bromide prints are certainly very much like prints done by the platinotype process, and I, for one, would not on all occasions undertake to distinguish between them. Platinotype, and therefore good bromide, prints are generally considered to be the most artistic in tone of all photographic prints. They have, to begin with, a dull, or matt, surface, and the tone of the picture is like that of copperplate engraving. The only reason why the bromide and platinotype processes do not make greater headway is because the general public prefer something bright and shiny for their money. The bromide paper has the advantage of platinotype in that it can be worked by artificial light, it is much cheaper, and it is far easier to work.

The Process.—The process is a development one—*i.e.*, the image is latent, and requires subsequent treatment, as in a negative. The paper is coated with an emulsion similar to that used for coating dry plates, and almost as sensitive. It is usually made in four grades: smooth slow, smooth rapid, rough slow, and rough rapid. The slow kind is suitable for both contact printing by artificial light and for enlargement by daylight; the rapid, for enlargement by artificial light. The question of surface is one of taste only, though rough is preferable for large work. The cost for all varieties is about 6d. per dozen sheets, ¼-plate size; ½-plate, 1s. 2d.; whole-plate, 2s. 3d.; 5 in. by 4 in., 9d.; and 8 in. by 5 in., 1s. 9d. The prices of the different makers vary slightly, but the above are about the average.

Where to procure the Paper.—Naturally, we will first of all have to obtain our bromide paper, and this we purchase ready cut for use, as fingering the surface would ruin it. There are many makers, but I have not found one paper specially better than another. The principal brands are: Eastman's; Ilford; Fry's "Argentotype"; and Mawson's; manufactured and sold by the following makers respectively: The Eastman Dry Plate and Film Company, The Britannia Works Company, The Fry Manufacturing Company, and Messrs. Mawson and Swan. Probably the best plan would be for the amateur to procure the paper from the maker whom he is in the habit of buying other goods from. If this paper did not suit him, he might then try each of the other makers in turn, until he gets a paper which suits him; for, because one brand works well with one person, it does not follow that the same brand will work well with another person, or that a different brand will give as good results in the hands of that person. That there is individuality in photography, no one who has studied the art to any extent can possibly deny. How to define it is another matter. It would almost seem as if the essence of one's taste and personality was concentrated in the tips of one's fingers, and was diffused into the developing and toning baths, influencing the plates and prints, and giving them a character of their own.

Exposing the Paper.—Before opening the packet of paper, the negative must be placed in the printing frame, and the film cleared of dust with a camel-hair brush or soft handkerchief. The packet of bromide paper is then opened similarly to an envelope: of course, this must be done in the "dark room." It will be found that the paper is enclosed in three or four envelopes, the flap of each of which is inserted at the bottom of the envelope containing it. This is done to prevent any chance of light having access to the paper; and it is necessary to be particular that no light does get to it; for, as already stated, the emulsion with which the paper is coated is almost as sensitive as that with which dry plates are coated. The packet having been unfastened, we take a piece of the paper and lay it on the negative. If any difficulty is experienced in distinguishing the coated side, it is only necessary to notice which side of the paper *curls inward* when it is taken out of the packet: this side is the coated side. The paper having been placed in the desired position on the negative, the printing frame is closed in the usual manner, not omitting to insert a few folds of blotting-paper or a felt pad between the paper and the back.

The printing frame should then be exposed to the light of a kerosene lamp or gas, a sheet of ground glass or a frosted or opal globe being interposed to diffuse the light evenly. The distance from the lamp is generally two or three feet, but should be altered according to the tones required, always remembering that *doubling the distance quadruples the exposure required: e.g.*, if a negative placed 1 ft. from the source of light requires an exposure of twenty seconds, when placed 2 ft. from the source of light the same negative will require eighty seconds of exposure. A long exposure should be given for light tones,

and a weak developer should be used; while for dark tones give short exposure, and make the developer strong, using at the same time a larger proportion of bromide. It is somewhat difficult to judge the printing qualities of a negative without actual trial, which may be made in the following manner: When taking a trial print from a new negative, expose the whole surface for only half the estimated time; then shield off two-thirds of the plate, and give another half-time; and finally, shield the last third of the plate, and give another half-time. The several portions of the resulting print will then have received half, full, and one-and-a-half times the estimated exposure, and on being developed it will be seen which portion was correctly timed. For ordinary bromide printing, the best plan is to give comparatively long exposure and use a weak developer, with somewhat more bromide solution than is generally prescribed; but as the addition of bromide to the developer markedly increases the contrast in the print, it should be added with caution.

One of the great advantages of bromide paper is its power of admitting of compensation in the case of a bad negative; thus, a negative, too thin to be used for silver printing, will give a good print on bromide paper by exposing 6 or 8 feet from the flame; again, a negative with strong contrasts, which would only give a sooty and chalky silver print, will generally give an excellent bromide print by exposing close to the flame—say about 3 inches from it. A very good average distance to work at for an ordinary good negative is 2 feet. Once you have found the correct exposure for a certain negative, it should be noted, together with the distance from the light, in a notebook kept for the purpose.

Our friendly Editor now reminds me that he prefers short articles, so as to interest more readers in each single number of WORK, and that I must either draw to a close quickly or leave the remainder until another number. The former I cannot do, for quickly must mean imperfectly, so, by his lenity, I take the latter alternative.

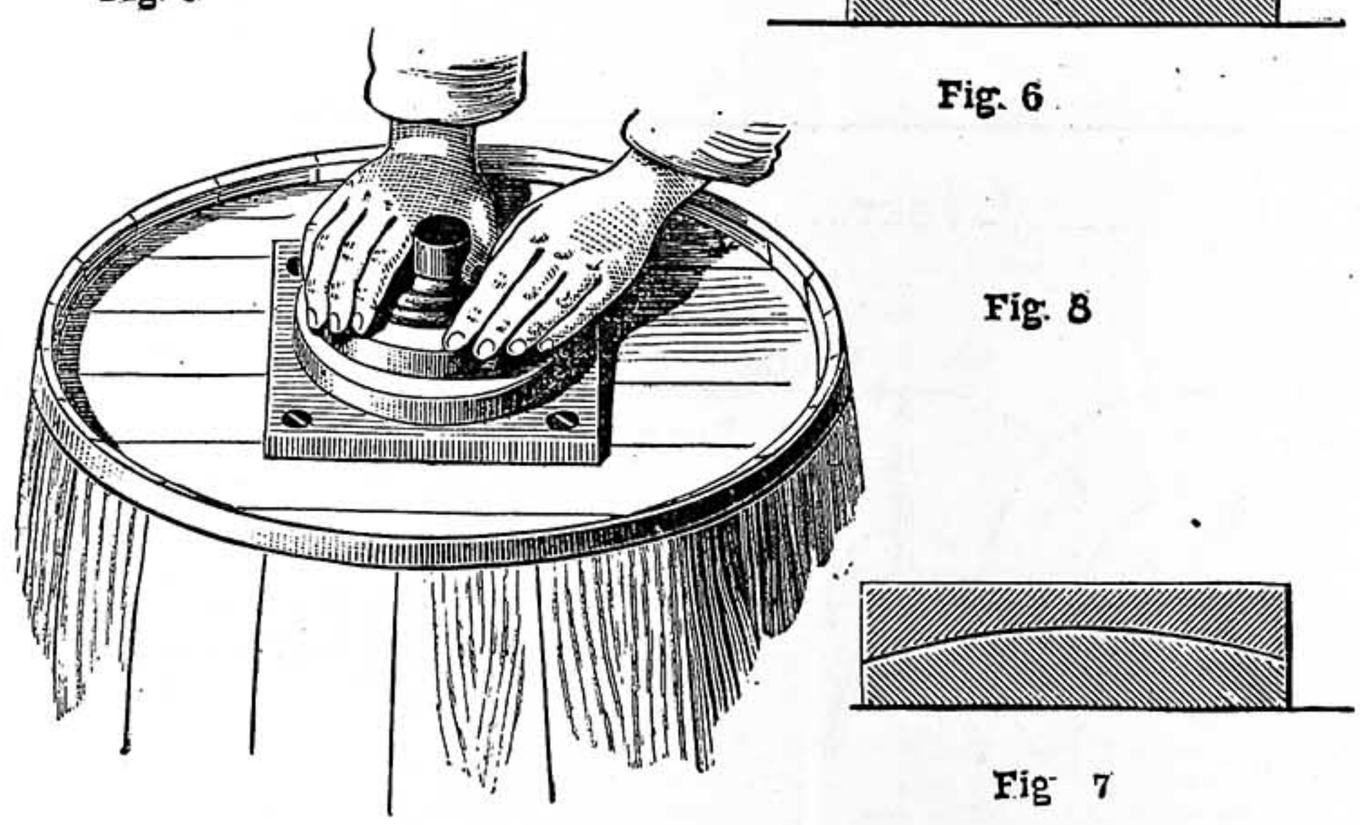


Fig. 3.—Convex Tool. Fig. 4.—Hone Square Tool. Fig. 5.—Discs. Fig. 6.—Overhanging Disc. Fig. 7.—Curved Section. Fig. 8.—Method of working the Speculum over the Tool.

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

HOW THE SPECULUM MAKER WORKS—THE OLD METHOD AND THE NEW—THEIR SIMILARITY AND DIFFERENCE.

As the simplest way to convey a general idea of the process of speculum making, we shall rapidly examine the method followed by the old workers in metal; for the modern method of working is identical in principle with that of the seventeenth century.

In the centre of the workshop stood a small, firm bench, or post, or barrel, of such dimension that the workman could walk quite round it, and reach over to every part of it without effort. In the centre of this bench was placed the first convex tool (Fig. 3), formed of the same metal as the speculum. Moistened emery was spread on this tool, and the concave metal was worked in every direction over it, until the surface became sufficiently true and smooth. The furrows in the tool, and the little central depression, allowed the abrading material to circulate freely and cut evenly. A second tool (Fig. 4), made of small squares of hone arranged on a convex basis, was then substituted for the first, and with this the speculum was fined ready for polishing.

A polisher was formed by covering the facets of the second tool with a mixture of pitch and resin, and on this the speculum was polished with rouge. During the last process the parabolic curve necessary to obtain good definition in a telescope was communicated to the concave mirror.

During the whole time of working the operator walked ceaselessly round and round the bench, and he changed the line of movement of the inverted speculum at each stroke, and when he desired to alter the curve of the speculum, he altered the length or variety of the stroke with which he moved it to and fro over the tool or polisher. He knew from experience the effect which any such change of stroke must cause, and in this knowledge lay his skill.

The practical optician still works his glass specula on convex metal tools, and still polishes them on pitch. But the tool of hones is dispensed with, and we shall dispense with the metal tools also.

We shall use only two similar discs of polished plate glass. One of these will ultimately form the speculum; the other will be the tool. On the glass tool, covered with pitch, the speculum will be polished with rouge, and we shall be able thus to dispense with the metal tools. For if two flat discs of glass be placed one over the other, with emery between them, and the upper disc be pressed down and worked to and fro in every direction over the lower, the emery will cut away the centre of the upper and the edge of the lower disc.

Thus, in Fig. 5, the two discs are at rest. In Fig. 6, however, at the end of a stroke, the upper disc overhangs the lower, the centre of the one pressing on the edge of the other, and the tendency is to wear away the two surfaces and produce the curved section shown in Fig. 7.

Fig. 8 further explains the working. The tool is cemented to a wooden slab, and then screwed firmly to the rigid bench, and the speculum, with a handle cemented to the back of it, is worked to and fro in such a manner that no two consecutive strokes lie in the same direction. Thus the concavity in the upper disc is regularly cut. As the workman walks round and round, he causes the speculum to rotate slightly under his hands at each stroke. The necessary muscular action is easy and natural, and a very little practice will suffice to form the habit of almost unconscious performance.

When the two discs have been sufficiently shaped, the grinding is continued with a series of emeries of finer and finer grades, until the glass is so far smoothed that emery can do no more. Then the polishing is completed on pitch, with rouge. So that, as has been said, the process of hand-working in the nineteenth century is practically identical with that of the seventeenth century.

ABOUT WORK AND POWER.

BY W. C. CARTER, M.I.MECH.E.

WE have seen that the Modulus of a machine is that fraction of the whole work put into it which appears at the working end of the machine. When, therefore, Dr. Joule addressed himself to the task of determining with exactness how much work corresponded to any given amount of heat, he naturally concluded that the best way to do it was to make a machine which would turn work into heat, because the amount of work done by a falling weight could be exactly ascertained as a starting point. And here it is

interesting to notice that as he wished to turn all the work into heat, the problem was really to make a machine, of which the modulus was 0 (see No. 158, page 20), a machine which did not possess any efficiency at all, as no useful work was given out. This he accomplished in the following manner. He had a simple arrangement constructed, by which the work done by a falling weight could be transmitted with as little loss as possible to a system of paddles working in a box containing a known quantity of oil. The paddles, by dashing the oil against internal vanes and obstructions, raised its temperature by an amount easily measured by thermometers. Every precaution was taken to prevent any escape of heat in any other way, and the result was determined which has now been accepted as sufficiently accurate for all purposes, and named, in honour of the experimenter, Joule's Equivalent, or, the Mechanical Equivalent of heat. Its value is 772 foot-pounds for every British Thermal Unit. The B T U is that amount of heat which will raise 1 lb. of water 1 deg. in temperature, so that we have here the data required to compare heat and work in any circumstances, and to definitely fix the natural connection between them.

We may now direct our thoughts to the other extreme of Mechanical Efficiency; that is, where the Modulus of the machine is 1. In other words, no work is lost by the internal friction of the machine, and all the work put in at one end is given out at the other. A little reflection will show that, owing to the properties of materials, we could never actually reach this refinement however nearly we might approach to it by fine workmanship. Suppose, for the sake of argument, that we could destroy all internal friction, we should have obtained the often-sought chimera—perpetual motion—and even then we should have no useful result.

Suppose our machine would run round for ever after we had put in a certain amount of work, even then we could put it to no useful purpose, because if we used up the work to do anything useful we should just be able to use what we put in, and our machine would stop again. Viewed in this way, how absurd the idea appears which has occupied many minds—that of forming, by the expenditure of a little work, an inexhaustible fountain of work that could be drawn upon, like the purse of Fortunatus, for ever without diminution. "What shades we are! What shadows we pursue!"

We shall now endeavour to make plain, in several illustrations, the truth of the foregoing remarks, and give such examples as shall show how to apply the Principle of Work to any machine, however complicated. We will begin with the Mechanical powers.

1. *The Wedge.*—Here we have, in Fig. 1, a wedge having a length of L ft. and a height of H ft. This constitutes our machine, and by applying a force F to it, we force it through a distance L, doing, thereby, an amount of work equal in foot-pounds to F lbs. × L ft., whatever they happen to be. But the weight (W) under which the wedge is driven is, during this time, raised a comparatively short distance, H, and the work at this end of the machine is W lbs. × H ft., and by our principle this product must be equal to F × L—neglecting friction—so that the less we make H the more W may be, which everyone knows by experience, that is, the finer taper the wedge has the more power it can exert.

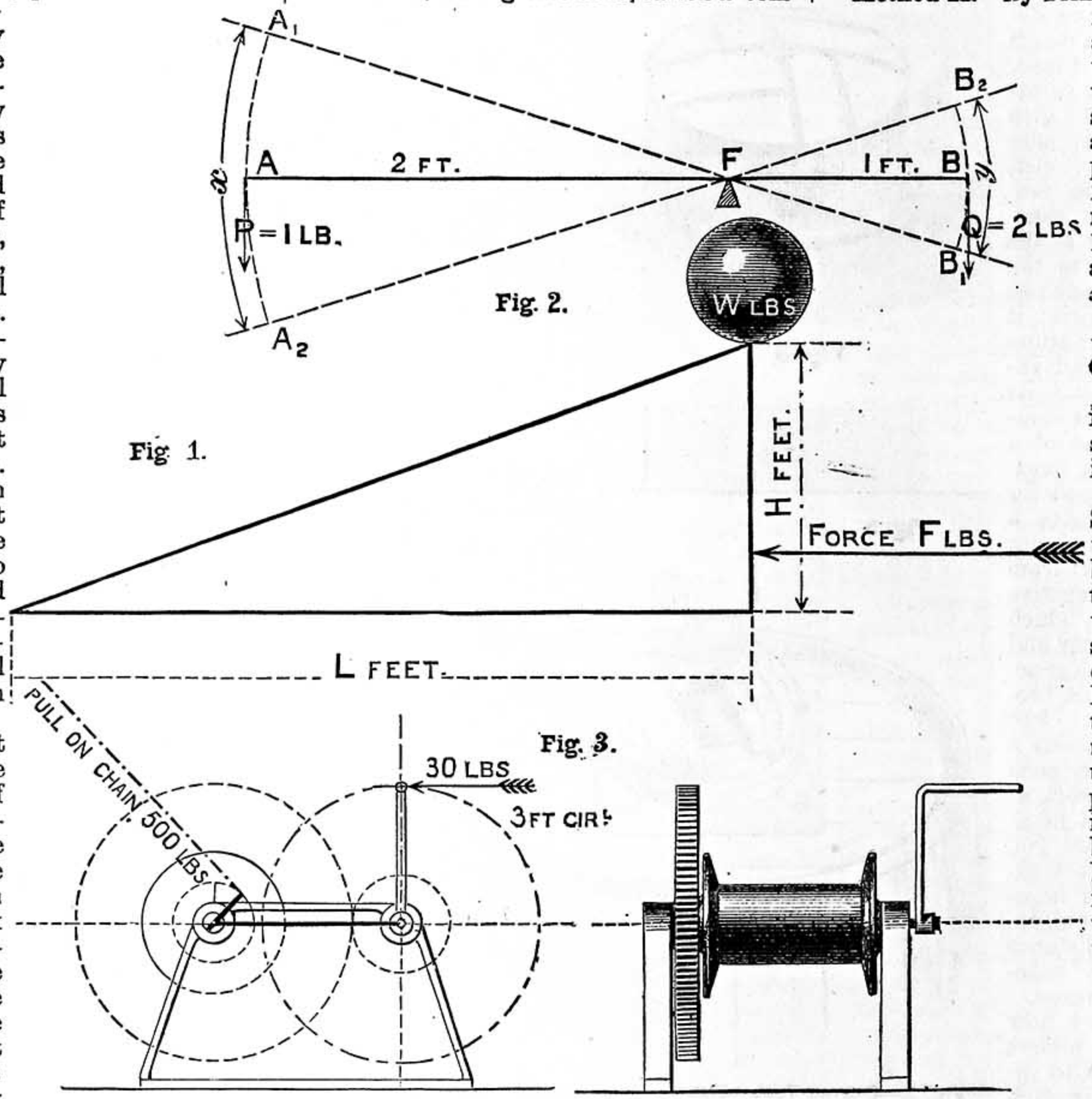


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1.—Wedge. Fig. 2.—Arms describing Arcs. Fig. 3.—Train of Spur Wheels.

2. *The Lever.*—The usual, and indeed the simplest, treatment of the lever is to consider the relative length of the arms as deciding the relative powers, but by looking a little deeper we see that, after all, the Principle of Work is at the bottom of it. Referring to Fig. 2, we see that the ends of the arms describe arcs of circles, and we know that the whole circumference of any circle is proportional to its diameter (as it is equal to diameter × $3\frac{1}{7}$), and, therefore, to its radius; and also that arcs containing any given number of degrees are proportional also to the radius of the respective circles. We must also remember that the number of degrees in the arcs described by the opposite arms of any lever must be equal whatever their length may be.

The arcs described by the ends of the lever represent the distances moved by each force, and so we can find the work at each arm of the lever, which we know must be equal. For the sake of comparison we will work the case in the figure both ways.

Method I.—Usual treatment.—The forces applied at the ends of the lever will be in inverse proportion to the lengths of the arms—that is, as the arms are as 2 : 1, then the respective forces will be as 1 : 2.

Method II.—By Principle of Work.—The force at A moves along the arc x, and that at B through the arc y. We have seen that x and y are in the same proportion as A F : F B, therefore we can represent them by 2 : 1. But the work done at x is P (force) × x (distance) = 1 × 2 = 2. And the work done at y is Q (force) × y (distance) = 2 × 1 = 2. So it is clear that the result by either method is the same.

Method III.—Spur Wheels.—It will be easily seen by referring to Fig. 3 that a train of spur wheels is simply a system of levers, because at any particular moment the portions of the wheels not in contact are useless. The active part of the wheels is shown by the black lines. We have here, instead of the imaginary arcs dotted at the ends of the levers in Fig. 2, complete circles, and consequently the application of the principle should be very plain.

Our figure shows the usual arrangement for a single-purchase hand winch. The power is applied at a handle which, for simplicity, we will suppose to be of such a length that it describes a circle measuring 3 ft. in circumference. Suppose a constant pressure of 30 lbs. is applied to the handle, then the work put into the machine is 30 lbs. × 3 ft. = 90 foot-pounds in one revolution. Suppose that we want to lift a weight of 500 lbs. by this winch, and we know that we get 90 foot-pounds for each turn of the handle; then the weight must move $\frac{90}{500}$ = ·18 ft. or 2·16 in. for each turn of the handle, and the intermediate wheels and size of chain barrel must be so arranged as to give this speed of lift.

Supposing that we had, instead of the simple winch here shown, a complicated sheer-legs winch driven by an engine, precisely the same principles would apply. We should have to calculate the mean pressure of the steam upon the piston by the usual

means, and multiply it by the distance moved in a minute by the piston—that is, the piston speed of the engine. This gives us the amount of work passing through the gear of the sheer-legs in one minute, and we know that, whatever complications may exist, the weight on the hook, multiplied by the speed of lift per minute, ought to equal exactly the work developed by the engine in the same time, friction being disregarded. Of course, it must be understood that in the case of large machines the friction becomes a very important factor, but we are here dealing with principles only, and when once these are grasped it will be a comparatively easy matter to make such corrections as experience of the efficiency of similar machines may suggest. If we once know the Modulus of a similar machine, all we have to do is to find the theoretical work to be expected—neglecting friction—and multiply it by the Modulus for any particular case.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

SECONDARY INDUCTIVE EFFECTS — INDUCTION IN PARALLEL STRAIGHT WIRES—HOW TO DETECT INDUCTIVE EFFECTS—HOW TO MAKE A DELICATE GALVANOMETER—HOW TO MAKE AN INDUCTION COIL—THE CORE OF AN INDUCTION COIL: HOW CONSTRUCTED — THE PRIMARY WIRE OF AN INDUCTION COIL: HOW SELECTED —THE SECONDARY WIRE: HOW SELECTED AND INSULATED—THE MAGNETIC BREAK, OR INTERRUPTOR.

Secondary Inductive Effects.—A current of electricity passing through the coils of a wire helix not only exercises an inductive effect on the coils of its own conductor, but also influences the condition of another conductor placed parallel to it, yet separate from it by a thin air space. Even when straight wires are run along side by side, the conductor of electricity will exert an inductive influence on its near neighbour, providing the two are not too far apart or separated by a very dense insulator. This may be demonstrated by means of very simple apparatus and a delicate galvanometer.

Induction in Parallel Straight Wires.—Get a piece of plain deal wood, 1 ft. in length by 3 in. in width, and 1 in. in thickness. About $\frac{3}{4}$ in. from the ends, bore two gimlet holes; in these fit wood pegs, with slits in their tops, $\frac{1}{8}$ in. apart; in these slits fix two naked copper wires of from No. 24 to No. 28 gauge (either or any intermediate size will serve our purpose), and stretch these wires from peg to peg, side by side, like two telegraph wires. Connect the two ends of one wire to the terminals of a delicate galvanometer, and the two ends of the other wire to the terminals of the battery. Immediately on connecting the second wire to the battery a movement of the galvanometer needle will be noticed, showing that a current of electricity has passed through its coils. On disconnecting the battery wire, another movement of the needle will be noticed, thus showing that inductive effects are produced both on making and breaking contact with the battery. These effects are only momentary, and are only observed at the instant of making and breaking contact. If now a file be employed on one of the battery terminals, and the battery wire is drawn along the file, so as to cause a succession of interruptions, the needle of the galvanometer will be kept swaying to and fro to right and left of the zero mark, thus showing that a succession of rapid interruptions in the main circuit is necessary to induce a continuous current in the secondary circuit. As these effects cannot be easily detected without a delicate galvanometer with a poised needle, I herewith give instructions for making one.

How to Make a Delicate Galvanometer.—Procure a piece of mahogany, or other hard wood, 4 in. square by $1\frac{1}{2}$ in. in thickness, and turn out of it a disc of wood $3\frac{3}{4}$ in. in diameter, having a central raised boss on one side $2\frac{1}{4}$ in. in diameter by $\frac{5}{8}$ in. in height (as shown at Fig. 2). Next get a piece of boxwood, and turn out a bobbin, $1\frac{1}{4}$ in. in diameter, a depth of $\frac{1}{2}$ in., and flanges $\frac{1}{4}$ in. deep by $\frac{1}{16}$ in. in thickness. Cut this bobbin into two equal parts, and glue the two halves to the centre boss of the galvanometer stand, about $\frac{3}{8}$ in. apart (as shown at Fig. 3). Wind each half with $\frac{1}{4}$ oz. of No. 36 silk-covered copper wire, one half being wound from left to right, and the other in the contrary direction, as in winding the magnets for electric bells. See that the wire is wound on evenly and free from kinks, then bring the two ends down through the base of the instrument, to be connected to the stems of two binding screws when the instrument is finished. Get a disc of thick white cardboard equal in diameter to the centre boss of the stand, divide it into two equal parts by a thin ink line, then subdivide each part into two equal parts, mark out two parallel lines with an inked compass leg near the outside rim of the disc, and divide this by fine lines into numbered degrees (the card may also be divided as shown by Mr. H. A. Miles, in his paper on "A Tangent Galvanometer," p. 57, Vol. III.). In the centre, on the underside, glue a small piece of cork, and through this press the point of a sewing needle until it stands $\frac{3}{16}$ in. above the surface of the card. This will form the pivot for the magnetic needle of the instrument. The card may now be glued down to the bobbins, with its zero line coinciding with the division between them. We must next get a small compass needle $1\frac{1}{4}$ in. in length, or make one out of crinoline steel to the form shown at Fig. 4. Needles are made and sold for this purpose at from 4d. to 6d. each, already capped and magnetised. If we make one ourselves, we must be sure to have very hard steel, and drill the centre hole much larger than required to go on the needle. This will then have to be capped with a brass cap, having a conical hole in the centre (as shown in section at Fig. 4*a*). After the needle has been formed, it must be magnetised by rubbing it on a permanent horseshoe or bar magnet, or placing it in a coil of wire through which a current of electricity is made to pass. When the needle is poised on its pivot, it should act as an ordinary mariner's compass needle, and lie at rest, with its ends pointing due north and south. The whole card and coils should now be covered with a glass-topped box, to keep out dust and to prevent the needle from being swayed by air currents. The ends of the wires should then be connected to two small binding screws on the base, when the instrument, as shown at Fig. 5, may be said to be finished. This instrument will be equal to those advertised for sale at from 2s. 6d. to 3s. 6d. each. It will do very well for delicate experiments in a room free from oscillation, but not for general detector work. The tangent galvanometer described by Mr. H. A. Miles in No. 108, p. 57, Vol. III., will also serve our purpose.

How to Make an Induction Coil.—To demonstrate the principle on which these coils are constructed, it will only be necessary to wind a quantity of fine insulated wire over the primary coil used in the first previously mentioned experiments, connect the ends of this fine wire with the galvanometer, and repeat the experiments over again with this addition to the coil. It will have been seen that to make an induction coil for any useful purpose, it is necessary to have the following parts:—(1) A core of soft iron; (2) a primary coil of stout wire wound on the core; (3) a secondary coil of finer wire wound over the primary coil; (4) a magnetic or other automatic apparatus for interrupting the current in the primary coil. These are the four essential parts. Other parts may be added for special purposes, and special coils have been made to meet special contingencies, some of which will be noticed in their places.

The Core of an Induction Coil.—This must be of soft iron. If made solid, it should be well annealed by heating to redness when finished, and allowed to cool down gradually in hot ashes. Solid cores are, however, slow in action, as they do not readily respond to the inductive influences of the current, nor give up quickly their charge of induced magnetism. The best material for the core of an induction coil is a bundle of soft iron wires, sold as iron binding wire. The sizes most suitable are No. 22 or No. 20. If the wire is already soft, it may be cut into the lengths required for the core, bound into a bundle with twine or tape, and soaked in melted paraffin wax to insulate the wires, keep them from rusting, and give coherence to the bundle. If the wires are not soft, they should be bound with iron wire into a bundle and annealed, as directed for a solid core, before they are soaked in paraffin wax. A spark coil may be built up from the core, having this for a foundation to form the body of the coil bobbin; but a shocking or medical coil should have the core sliding in a tube or a loose tube surrounding it. Metal of all kinds must be rigorously excluded from the body of the coil bobbin, since metal tubes themselves absorb inductive effects instead of transmitting them to other conductors. It is advisable to have the tube, forming the coil bobbin, of as thin and as perfect insulating material as possible, consistent with strength, since inductive effects are absorbed in thick tubes. Ebonite is one of the best materials, since it is strong and a good insulator. Next to this is papier-mâché soaked in melted paraffin. Tough cartridge-paper soaked in melted paraffin will also make good tubes. Paper soaked in beeswax has been used, whilst some persons use shellac varnish, and others employ glue to stick the folds of paper together to form the body of a bobbin. The two last are, however, much too stiff and brittle to yield best effects.

The Primary Wire of an Induction Coil.—This is the first wire wound on the core. It is the wire through which the primary electric current passes. As it is wound over the core of soft iron, the passage of an electric current through it induces magnetism in the core, and the strength of this magnetism will be in proportion to the strength of the electric current sent through the coil. The strength of current permissible through the primary wire of a coil is limited to the safe carrying capacity of the wire itself. The size of wire employed for the primary coil varies with the size of the finished induction coil and its intended use. The sizes

vary from No. 12 to No. 24 in spark coils, the larger size being employed in large coils. In medical coils the size of the primary wire may vary from No. 18 to No. 24, the latter being employed when a coil consists of a long primary wire only, and when several powers are used together with that of the primary current. The wire should always be of high conductivity annealed copper, well covered with silk. Cotton-covered copper wire may be used, but the results will not be nearly as good as those from silk-covered wire. Before winding on the wire, it should be soaked in hot melted paraffin wax, to provide against possible defects in the insulation. This is a necessity in building spark coils. Some persons employ shellac varnish for a similar purpose, painting each layer as it is wound on the core; but this is too hard to give best effects. Other makers cover the core with paper soaked in hot beeswax, and coat each layer of primary wire with a layer of similar prepared paper. There is no insulator equal to paraffin wax for this purpose. The last layer of wire should have two or three layers of the prepared paraffined paper wrapped round it before winding on the secondary wire.

The Secondary Wire of an Induction Coil.—This is the wire wound over the primary coil previously described. It is usually a very long and thin wire, but may be made up of several wires of different gauges wound on over each other, the largest wires being placed nearest the primary coil. This arrangement is only adopted in building medical coils of various powers. Spark coils have only one long thin wire, usually of No. 36, 38, or 40 silk-covered high conductivity annealed copper. The wire must be well covered with silk, free from even the smallest uncovered spots, free from kinks, and continuous throughout the lengths to be employed. Should a break occur, and a knot have to be made, it must be a long splice knot of not less than ½ in. in length, formed of the bared and cleaned ends twisted together, then soldered, employing resin as a flux. The joint thus made must be coated with fine silk soaked in melted paraffin wax. Every layer should be wound on evenly, with the turns running regularly side by side throughout, and in the same direction as those of the primary coil. Inductive effects are lessened by crossing of the coils, as when the wire is run on without any attempt to lay it side by side. Intense or high pressure effects are also lessened by employing large wires, since the large wires absorb into themselves the increased pressure obtained by the inductive influence of a number of coils of fine wire acting on each other. Apart from this, the inductive effects are increased by the number of turns we can get in a small space in close contiguity to the magnetic field of the core, and the number of these turns are lessened by using large wire. Therefore, it is not advisable to use mixed gauges of wire in the construction of a spark induction coil, since our aim in this is to get a high pressure current at the terminal ends of the secondary wire. A long thin spark is obtained from the terminal ends of long fine secondary wires; a thick and short bushy spark is obtained from larger wires. Particular attention must be paid to the insulation of the secondary wire throughout the coil, as the least failure in this will cause several turns of wire to unite in absorbing the extra tension induced by other parts of the coil. What is gained in one part will be lost in another, unless all are alike good. The spark is said to leap across badly insulated parts of a coil and burn away the defective insulation, thus causing it to get from bad to worse. It is, therefore, advisable to examine closely the insulated covering of the wire for a secondary coil, and to run it through melted paraffin wax, to render the insulation of the covering doubly sure.

The Magnetic Break, or Interruptor.—It has been shown that there are no evidences of inductive effects in the secondary circuit of a coil until the current passing through the primary coil has been interrupted. It would be tedious to interrupt the current by drawing one end of the wire over a file placed in the circuit. We must, therefore, resort to some method of interrupting the current by machinery. Fortunately, we can easily arrange a regular and mechanical interruptor, worked by the primary current of the coil itself. As the current passes through

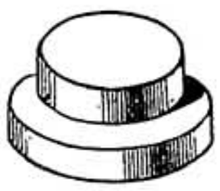


Fig. 2.

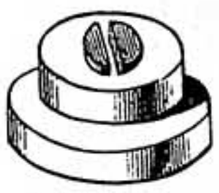


Fig. 3.

Fig. 3*a*.

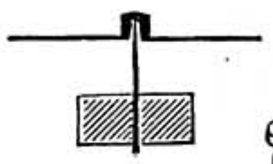


Fig. 4*a*.

Fig. 4.

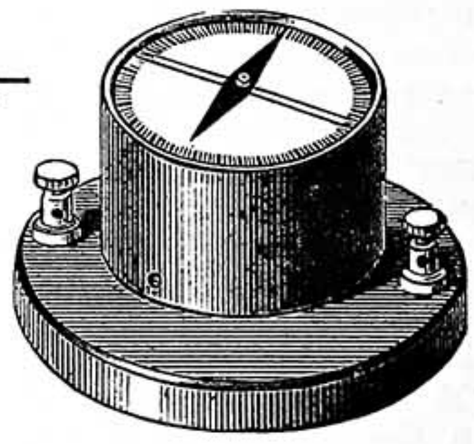


Fig. 5.

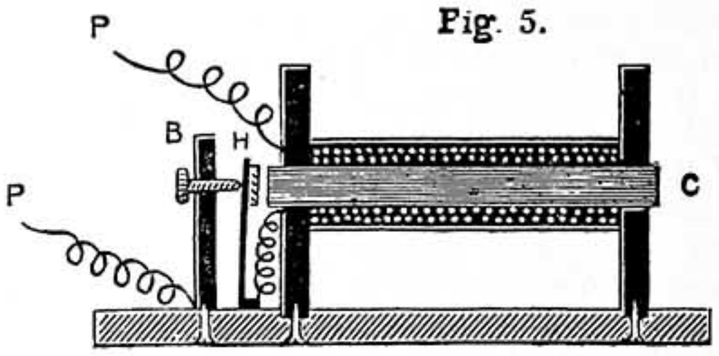


Fig. 6.

Induction Coils. Fig. 2.—Wood Base of Galvanometer. Fig. 3.—Bobbin Halves glued to Base. Fig. 3 *a*.—Half of a Bobbin. Fig. 4.—Form of Galvanometer Needle. Fig. 4 *a*.—Section of Needle, showing it poised on its Pivot. Fig. 5.—Galvanometer complete. Fig. 6.—Sectional Diagram of Induction Coil—B, Break Pillar; H, Break Hammer; C, Core of Coil; P, P, Ends of Primary Wire.

the primary wire, it converts the soft iron core on which it is wound into an electro magnet. This will attract to itself another piece of soft iron, so suspended as to be free to move toward the core. If we make this piece of soft iron a part of the primary circuit, it follows that its attraction by the core will at once break the circuit. If now we fix the piece of iron to a spring, also placed in the circuit, the magnetised core will first draw the soft iron to itself, and in so doing break the continuity of the circuit; a current will at that instant cease to flow in the primary coil, the magnetism of the core will also cease, and it will lose its hold on the iron, which will then be drawn back by the spring to again close the circuit. This to and fro movement will be rapidly executed and automatically maintained whilst current is passing through the primary coil. The action is clearly shown in the annexed diagram (Fig. 6), which gives a sectional view of the arrangement in a coil. In this diagram B represents the break pillar, H the hammer of soft iron, C the core of the coil, and P the primary wire. The details of construction will be given in a following paper.

HOW TO MAKE CORK PICTURE FRAMES.

BY ARTHUR YORKE.

FINISHING THE GROUND — ROUND, OVAL, AND FANCY-SHAPED FRAMES — DESCRIPTION OF THE DESIGNS—CONCLUDING REMARKS.

Finishing the Ground.—In two of the designs given with the former article, as well as in the whole of those which accompany the present paper, the ground is represented as having a roughened surface. A common way of doing this is by rubbing up scraps of cork as fine as sand and sprinkling this on the wood, after first giving it a coat of glue. But in careful cork-work the ground is sometimes completely veneered over with sheet-cork, either bought in that form or sliced up for the purpose; the best work can, undoubtedly, be made with the former. Supposing, however, that the wood of the frame has been so chosen that its colour matches with the cork, the ground will sometimes look well left as it is, quite plain; or a grounding-punch can be used on it, as in wood carving.

Round, Oval, and Fancy-shaped Frames.—As two of the designs attached to the present paper are of this class, it may not be amiss to say a word as to the easiest way of making the wooden foundations for such frames. Say that the shape is that of Fig. 9, or of Fig. 12, and the size not more than a foot in its greatest dimension; my own plan would then be to take two thicknesses of thin board, large enough when put together with the grain of the one crossing that of the other at right angles to include the whole frame; but before joining them I should saw them to shape with the bow-saw, cutting the front one to the pattern as it appears at sight, and working in it a shallow rebate, and cutting the hinder board so much smaller as to allow for the rebate. By using these crossed boards glued together the danger of warping would be obviated.

Description of the Designs.—Fig. 9, though it is here drawn as a round frame, may be equally well carried out as an oval one. Its more prominent decorations have been drawn as half balls of cork. They will look best in that shape; but should the novice find a difficulty in cutting them properly, he can substitute pellets instead—that is, mere sections cut from bottle corks. All the pieces in the two projecting borders end alike in triangular points; of these, the section, Fig. 13, shows by dotted lines the greatest projection, the line G H, through which this section is cut, being at their least projection; the position occupied by the line of balls (neither of which is intersected here) is also indicated by dots. The flat outer border is glued to the face of the frame (as may be seen in the section), leaving the sides uncovered.

In Fig. 10 it will be observed that a different plan is followed, the sides being covered by rectangular pieces of cork, alternately thicker and thinner, and these project beyond the face of the frame, so as to form a border to the pattern. No difficulty can be found in cutting the different pieces used in the flowers; it will be noticed that they all slope downwards from the central

line. This pattern is one which can well be employed where broader surfaces than picture frames have to be decorated with cork-work.

In Fig. 11 the plait pattern is wholly formed of pieces like those at A, Fig. 4, in the former article. The flower at corner is success will much depend on the worker's ability to cut out the foundation neatly with the bow-saw. The round ornaments in this frame are not semi-globular as in Fig. 9, but are supposed to be sections of small phial corks, the projecting ends of not be afraid to attempt. Cork-work may, however, be carried out in a much more ambitious spirit, and may be made to emulate high-class wood carving, not only in intricate conventional designs, but also in the imitation of natural objects, such as

Fig. 9.

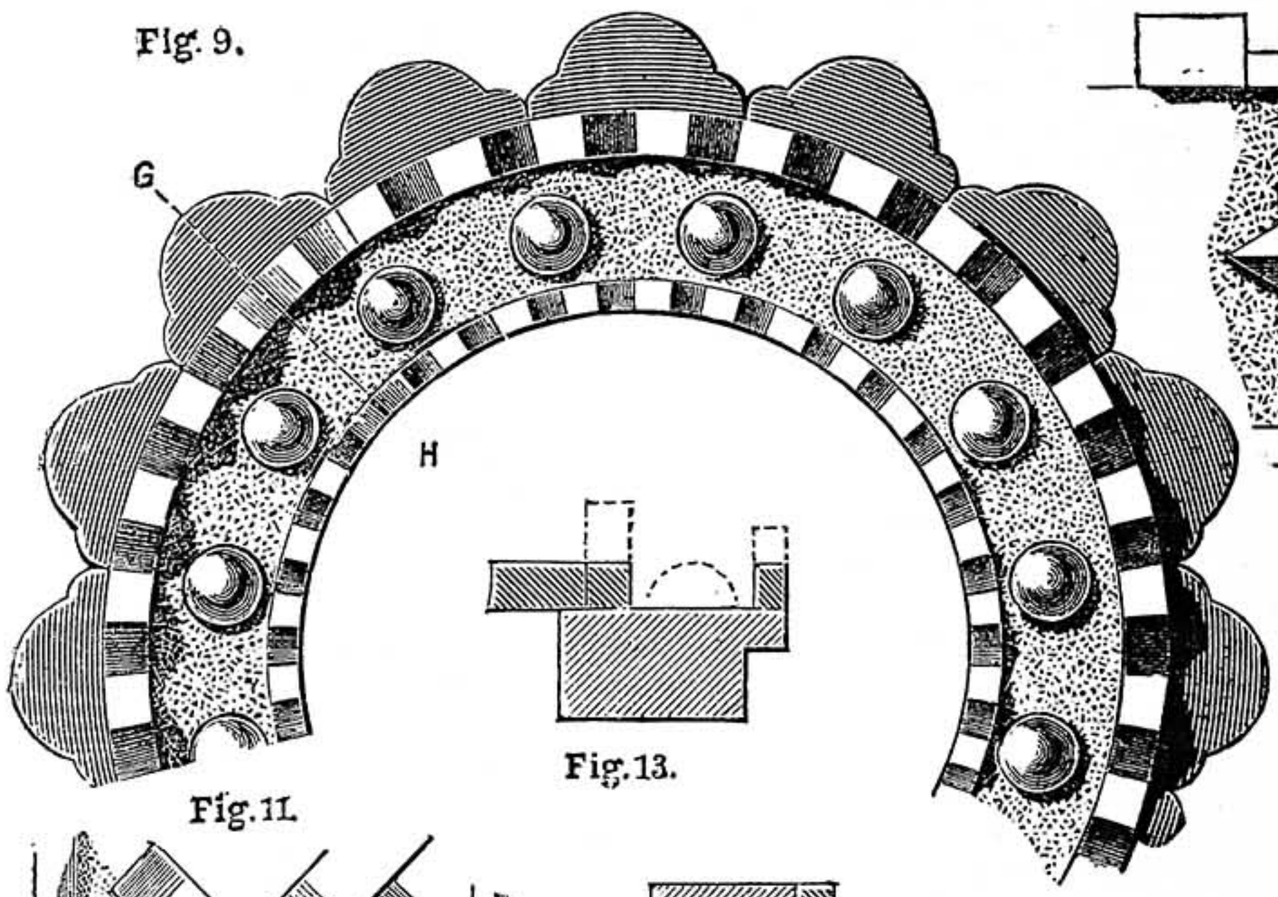


Fig. 11.

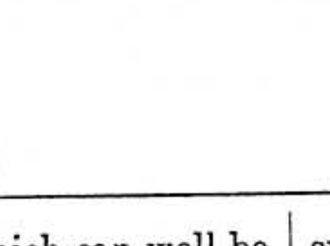


Fig. 13.

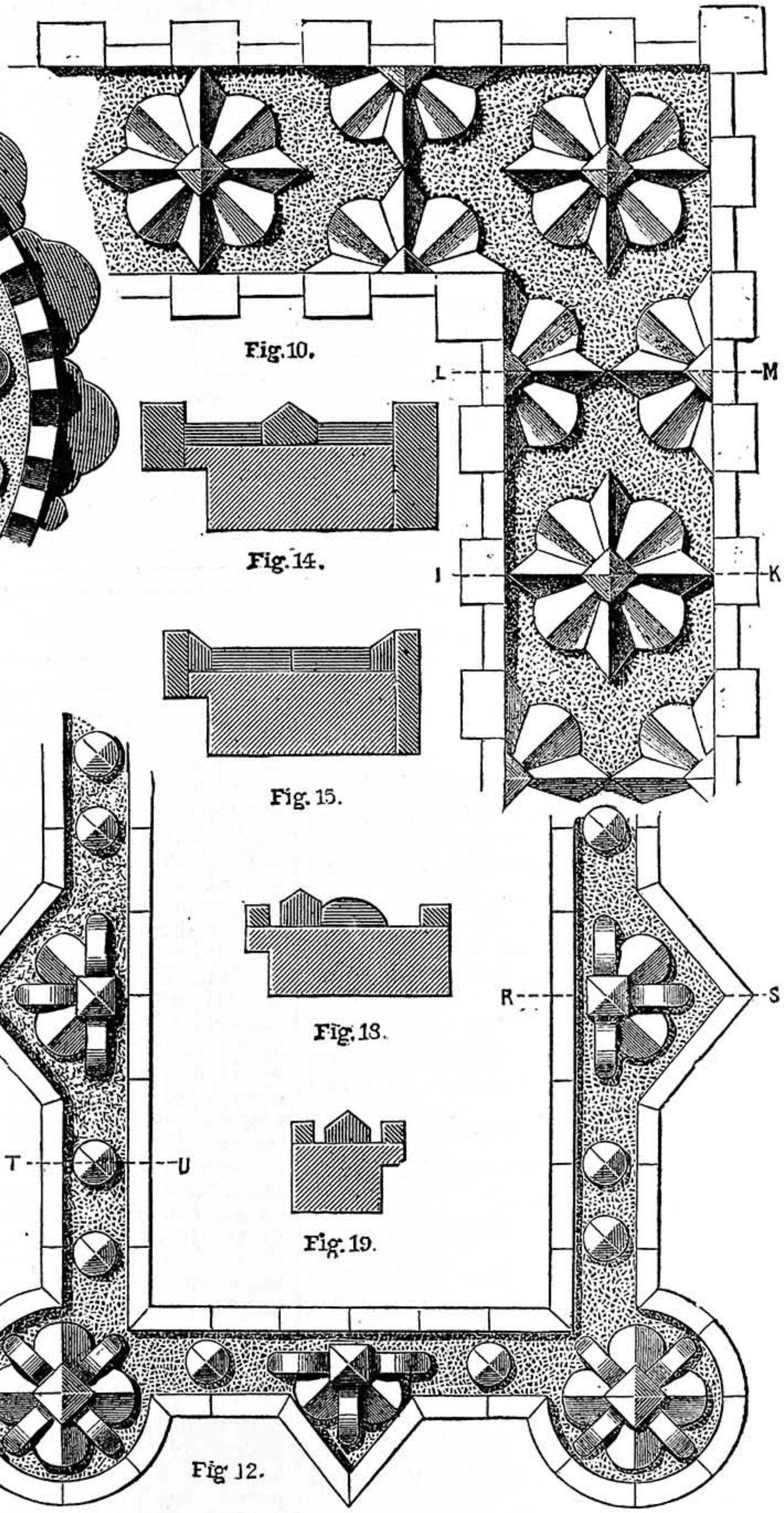


Fig. 10.

Fig. 14.

Fig. 15.

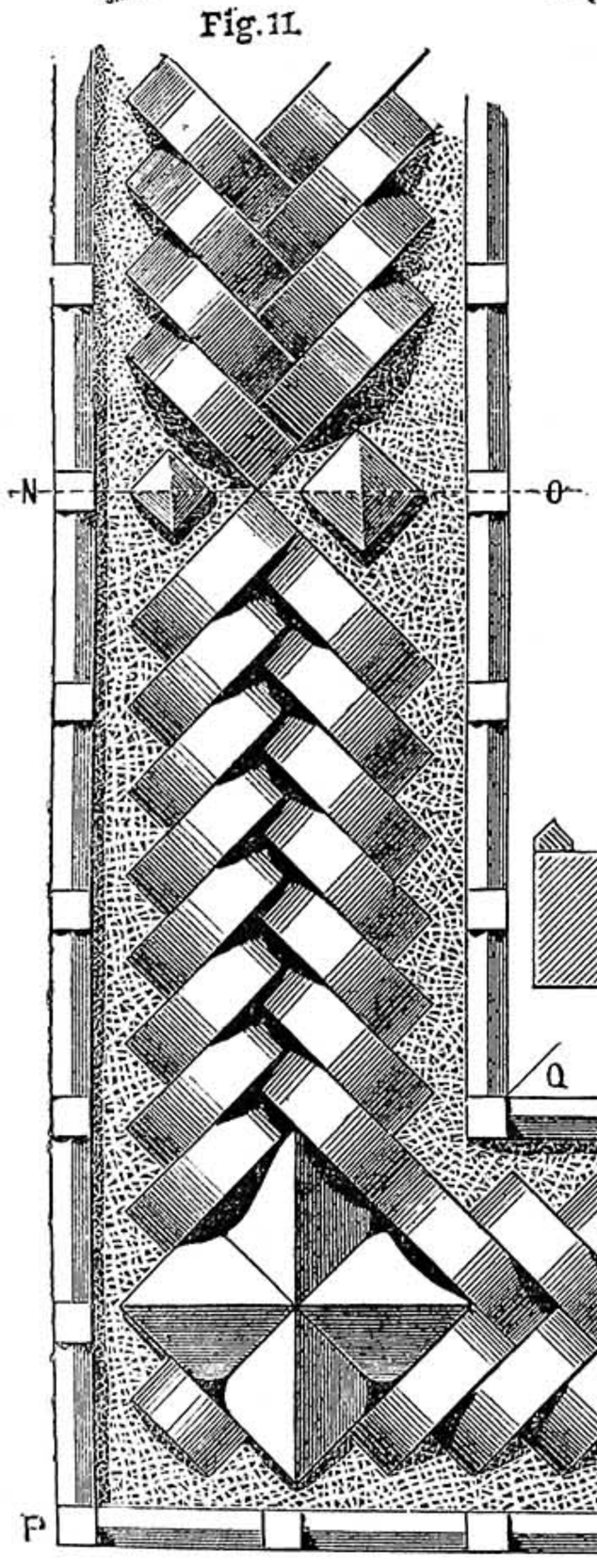


Fig. 17.

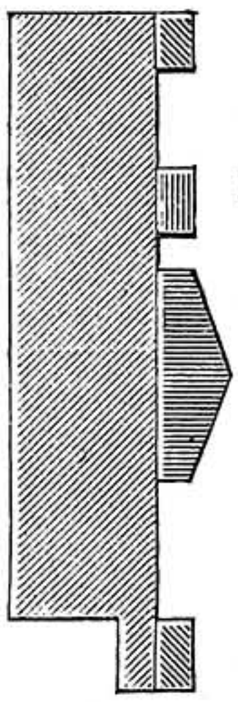


Fig. 16.

Fig. 18.

Fig. 19.

Fig. 12.

Cork Picture Frames. Figs. 9, 10, 11, 12.—Designs for Cork Frames. Fig. 13.—Section of Fig. 9 on line G H. Fig. 14.—Section of Fig. 10 on line I K. Fig. 15.—Section of Fig. 10 on line L M. Fig. 16.—Section of Fig. 11 on line N O. Fig. 17.—Section of Fig. 11 on line P Q. Fig. 18.—Section of Fig. 12 on line R S. Fig. 19.—Section of Fig. 12 on line T U.

in four pieces, which should be cut so thick as to be a trifle more prominent than the plait. This is shown in the section, Fig. 17. The border, which lies on the face of the frame, is of small cubes, alternating with longer pieces cut to a ridge on the projecting side.

The design, Fig. 12, is not one intended to be carried out on any large scale. Its which have been cut to a pyramidal form, as is shown in the section, Fig. 19. The section, Fig. 18, shows the projection of the parts of the incomplete flower at R S, and sufficiently explains the construction of the complete flowers in the corners.

Concluding Remarks.—In drawing these designs I have confined myself to simple patterns, such as a novice in the art need leaves, flowers, and fruit. Instead of being cut from the solid, the different forms would, of course, be built up, piece by piece, in cork. Whether the material is one which is worthy to absorb any high amount of taste or skill is a point for private judgment to decide. There are many articles beside picture frames in which the cork-worker can, if he desires, exercise his powers.

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INDIRECT TAXATION.—Dr. W. A. Hunter, M.P., who is perhaps most widely known in connection with his Pensions' scheme for workmen, is occupied just now in a fascinating investigation. He is trying to find out the share paid in Imperial taxation by the working classes, and the share paid by the rich, and some of the conclusions he has arrived at so far are sufficiently startling. The part of his conclusions that most concerns us here is, that if the revenue now obtained from the Customs and Excise in England (Scotland and Ireland being excluded) were obtained by a rate upon property, as the poor rate is obtained, the yearly saving to each working-class family would average £3 8s. 10d. The working classes, and those akin to them, he puts at four-fifths of the population; and the yearly contribution of these four-fifths to the revenue through the consumption of the taxed commodities—coffee, cocoa, dried fruits, tea, tobacco, beer, and spirits—is £4 16s. 10d. per family. Now he finds that the average house rent, outside London, of these four-fifths is £7 10s., and £4 16s. 10d. in taxes is thus equivalent to a rate of 12s. 10d. in the pound. That is the poor man's tribute at present by indirect taxation. If, however, this indirect system of taxation were superseded by a direct rate upon house rent, then the amount now derived from the Excise and Customs, viz., £28,000,000, would be obtained from a rate of 3s. 9d. in the pound. Such a rate on a rental of £7 10s. would be 28s. a year, the average that working-class families would then pay, instead of the £4 16s. 10d. they now pay. We say nothing about the unfairness of the present system, but simply add that Dr. Hunter does not propose to abolish the taxes on tea, tobacco, beer, and so forth, but to retain them for the purpose of pensioning the old, infirm, and disabled. Though the difficulty of adding a rate of 3s. 9d. to the already too heavy burdens of rent-payers may be insuperable, the question of indirect taxation is well worth the attention of our readers. There are few, probably, who would seriously contend that Imperial taxation generally does not hit the poor harder than the rich, even allowing for malt and tobacco—the quantities too often hurled at the heads of working men.

PETROLEUM ENGINES.—These engines, in which the vapour of petroleum oil is utilised as the motive power, though less known as yet than the gas and steam engines, are coming into favour. On the score of economy they compare favourably with engines driven by coal gas and steam; while the advantages claimed for gas engines, such as not requiring a boiler, and the being able to start at short notice, are also possessed by petroleum engines. Professor Unwin states, as the result of trials made by himself on a 5-h.p. Priestman engine, that taking the fuel consumption of 1 lb. of oil is equivalent to that of 1½ lb. of coal, then the consumption of the oil engine came out less than that of the most economical triple-expansion engine yet tested. Three trials of the 5-h.p. Priestman engine gave respectively an equivalent of 1·02, 1·18, 1·23 lb. of coal per brake-horse-power per hour, while the steam consumption in the most economical triple-expansion engine corresponded with 1·61 lb. of coal per brake-horse-power per hour. These oil engines are suitable for pumping, for driving dynamos in country districts, for working rock drills, for working air compressors, for fog signalling at lighthouses, and for driving launches and barges. As the engines do not reverse, provision is made for going astern by means of a reversing friction clutch. There is one great advantage which the oil engines possess over even the gas engines: that they are self-contained, and can be moved from place to place, no fixed gas pipes being required for connection. The action is very simple: a jet of oil, and a current of air, regulated by a governor, are mixed in a spraying nozzle, which reduces the oil to fine particles. These are received in a vaporising chamber, heated by a jacket of exhaust gas. An additional supply of air is drawn into the vapour chamber with the suction stroke, and the charge is ignited in the cylinder by an electric spark. Oil engines for small and moderate powers should divide the field with gas engines in the future.

LATHE WHEEL BALANCE.—Should there be a balance weight or not? We say, that depends. For instance, if it is a light lathe for wood turning, and especially if it be fitted with a traversing mandrel so that the workman will require to swing the wheel half round and back, then a balance weight will be in the way. But if, on the other hand, there be no traversing mandrel, and a balance weight is arranged as a counterpoise to the treadle, so that when it stops the crank will be in the right position for restarting, the workman will find the following advantages:—First, he can start without taking hold of the band or putting a hand on wheel or pulley—a great advantage in long work. Second, the rate of revolution will be more even. Third, the lathe can be driven very much slower without stopping. Fourth, the lathe may be stopped altogether at the beginning of the up-stroke by the foot alone, and by the foot alone it may be started and driven on again. And, altogether, a lathe is more under control and pleasanter to drive when fitted with a balance weight, if only the weight be not too heavy and yet sufficient to bring the crank up to the proper starting point when the belt is on the usual speed.

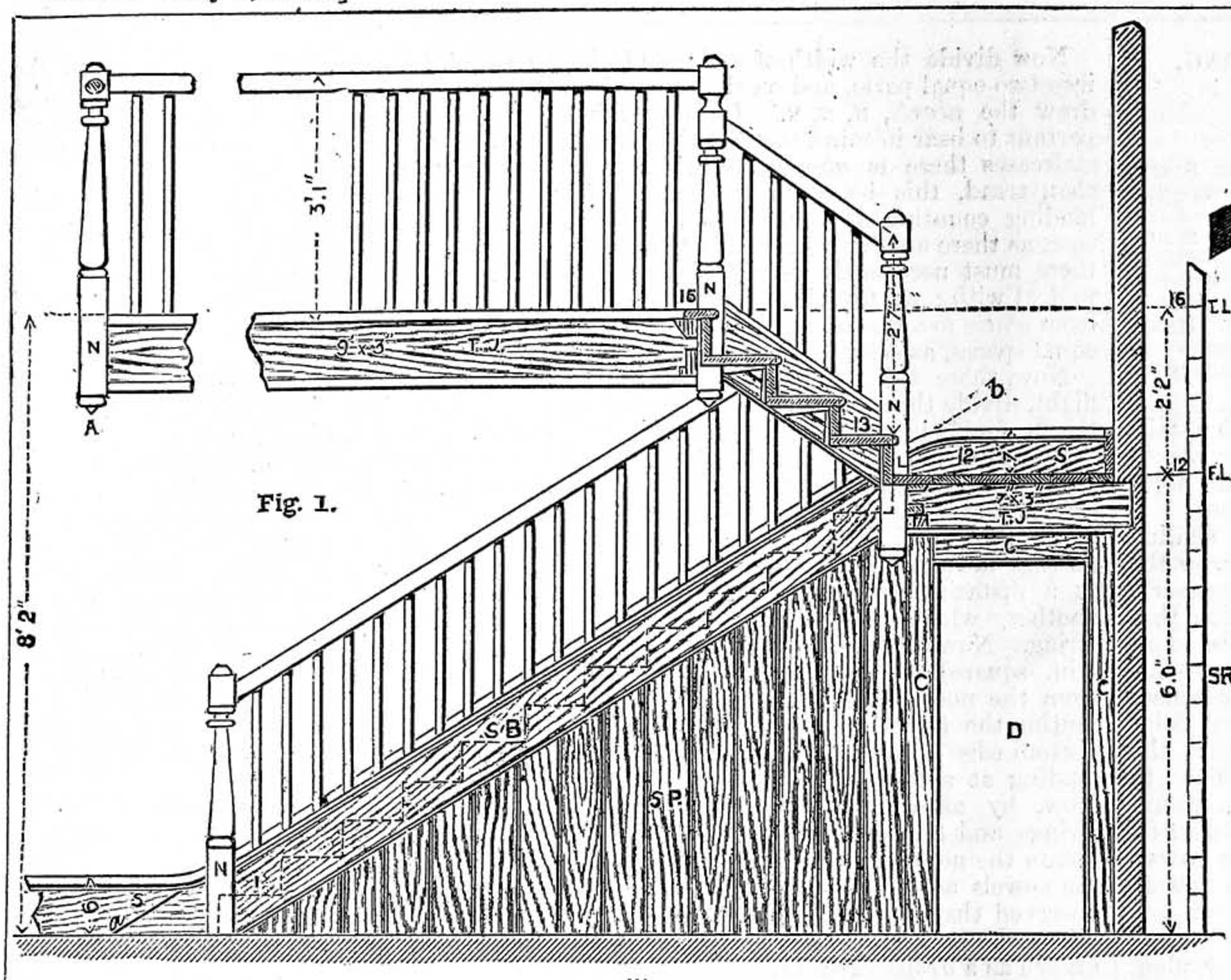
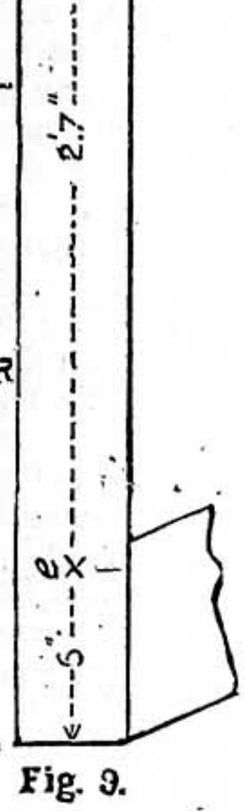


Fig. 1.



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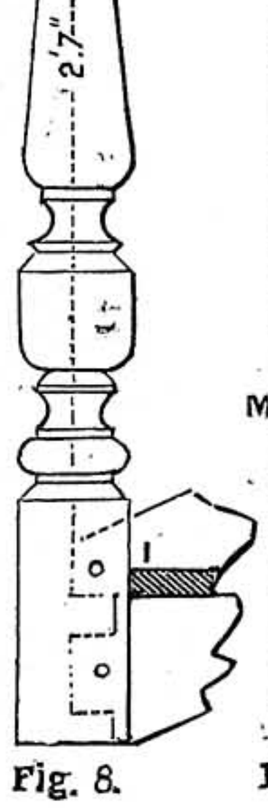


Fig. 8.

Fig. 10.

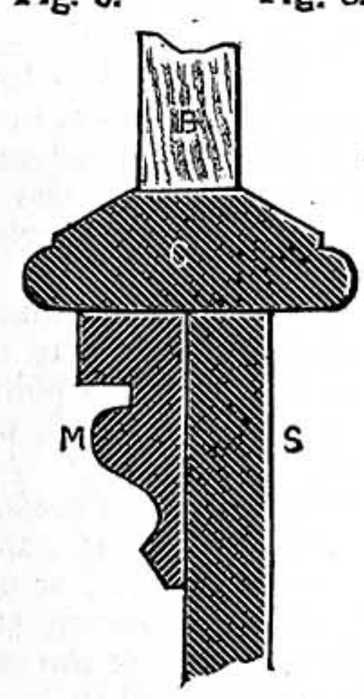


Fig. 11.

Fig. 2.

Fig. 6.

Fig. 7.

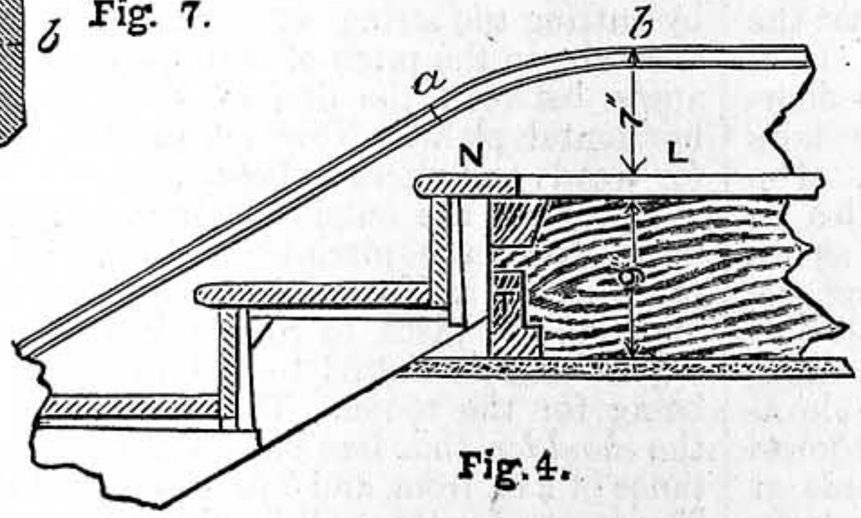


Fig. 4.

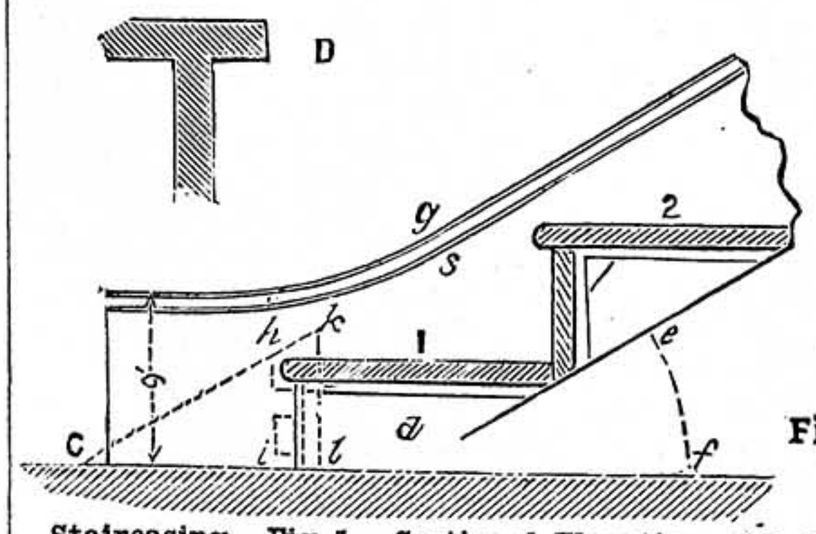


Fig. 3.

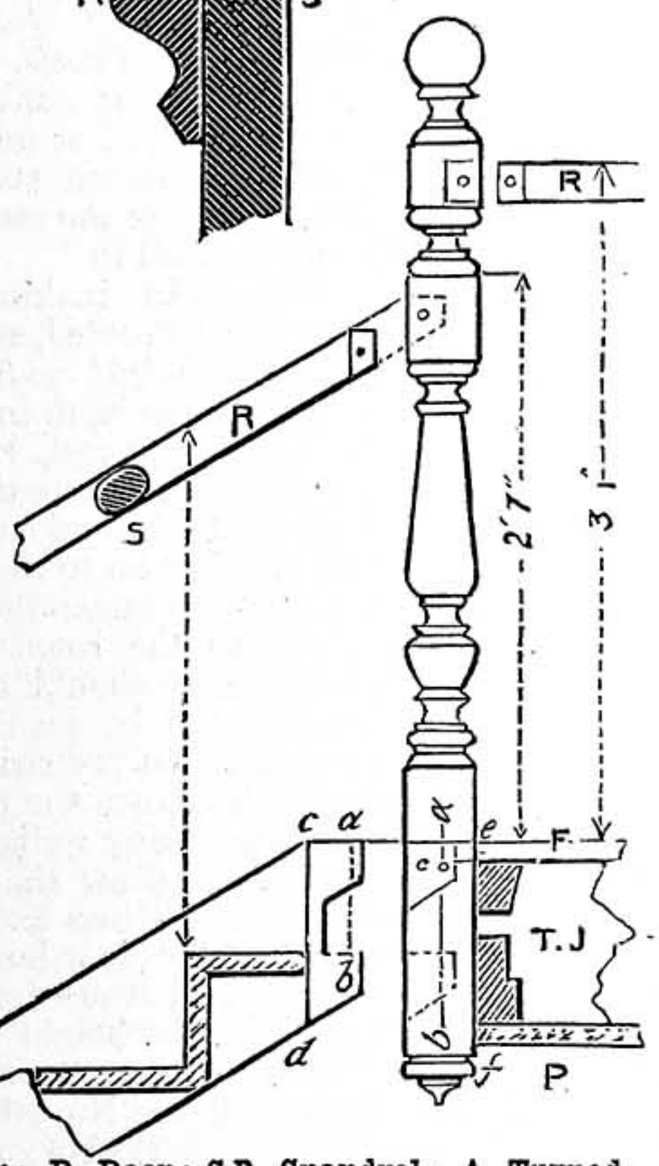


Fig. 5.

Staircasing. Fig. 1.—Sectional Elevation—S B, String-board; N, Newels; T J, Trimmer Joist; S, Skirting; D, Door; S P, Spandrel; A, Turned Drop; S R, Storey Rod; F L, First Landing; T L, Top Landing. Fig. 2.—Plan—L, L, Landings; N, N, N, Newels; W, W, W, 4½ in. Brick Walls; D, Door Opening. Fig. 3.—Details of String at Bottom—1, 2, Steps; *d e f*, Angle of Stairs; *c*, *s*, *t*, Piece glued on String; *k l*, Shoulder Line; *h*, *i*, Tenons. Fig. 4.—Details of String at Top—*a b*, Moulding on Casement; L, Landing; T, Trimmer; N, Nosing. Fig. 5.—Details of Newel on Landing—R, R, Rails; T J, Trimmer Joist; F, Floor; P, Plaster; *c d*, Shoulder; *a*, *b*, Tenons; *e f*, Depth of Landing; *s*, Section of Rail. Fig. 6.—Details of Tenon. Fig. 7.—Torus Moulding, *a* to *b* Portion nailed on String. Fig. 8.—Turned Newel ready for fixing. Fig. 9.—B, Bevel applied to Newel for Mortise and Square; *a b*, Mortise; N, Newel; *e f*, Height of Rail. Fig. 10.—Details of String as mortised in Newel—*a a*, String on Bottom Flight; *b*, String on Top Flight; H, H, Rails; N, Newel; B, B, Balusters; C, Cap; M, Moulding. Fig. 11.—Details of Cap, etc.—S, String; C, Cap; M, Moulding; B, Baluster.

THE ART OF STAIRCASING.

BY GEORGE F. CHILD.

INTRODUCTION—WINDERS—CLOSE STRING STAIRS WITH NEWELS—WORKING DRAWINGS—SETTING-OUT WALL AND OUTSIDE STRINGS—EASEMENTS FOR SKIRTINGS AT TOP AND BOTTOM—WORKING AND FIXING EASEMENTS—DEPTH OF TRIMMERS—RETURN FLIGHTS—SETTING-OUT NEWELS—CAPS FOR BALUSTERS—NEWELS ON LANDINGS—HEIGHT OF HANDRAILS—NOSINGS—BALUSTERS—SECTIONS OF HANDRAILS—SPANDRELS—REFERENCE TO FORMER FIGURES.

IN the preceding article we dealt with a staircase of the simplest kind, it being placed in such a position that one straight flight enabled us to reach the floor above.

The staircase we now propose dealing with is slightly more complex, as, under the conditions, we find two flights are necessary. On reference to Fig. 1, it will be seen that there are two landings, one being placed at a height of 6 ft. from the ground floor—this height is often varied to suit circumstances—the other being the level of the first floor. Of course, it will be understood that the sizes here taken are only for convenience, to save space. In practice, 8 ft. 2 in. would be much too low, it only giving about 7 ft. to the ceiling line, which the "Bye Laws" would never allow, 8 ft. being the lowest possible. However, this will answer our present purpose.

Winders.—It is always the better plan, where possible, to *avoid* winders—we shall deal with the subject of winders later on—as a landing affords a rest in a long flight of stairs, besides having the advantage of safety, it being obvious that the winders round the newels, gradually tapering, cannot afford the foothold that a landing would. It is also necessary, at times, to introduce a landing, as a door may open directly upon the staircase at this point, when winders, unless specially arranged, would be utterly impossible.

Close String Stairs with Newels.—This class of stairs is so named on account of the outside string-board being *close*, or uncut, as in the case of an open string staircase, where each step is cut out on the string itself, instead of being "housed in."

Working Drawings.—In making our working drawing, we must proceed, as in the last article, by taking the *height*, *width*, and *going* upon the storey rod, as seen in Fig. 1 (elevation), where S R is the rod, F L first landing, and T L top landing. Note that the "going" should properly be taken from the wall at back of landing up to the doorway, it being always better to keep the stairs clear of the entrance to the rooms. The depth of the trimmer joist should also be taken, for reasons that will be seen as we proceed with our work. In preparing the working drawing, first lay down the plan as in Fig. 2, drawing all enclosing walls, doorways, and landings. Next draw the elevation (Fig. 1), marking all landings and joists as shown, allowing $\frac{7}{8}$ in. for floor-boards at the top, and the same at bottom for laths and plaster. Now divide the height to first landing into as many parts as convenient, as given in former article (see No. 160, page 51), which we have taken as twelve; now do the same from the *first* to *top* landings. This, it will be seen, gives four risers.

We now see how this will work for our "going." It will be observed that the first landing projects 2 ft. 9 in. from the wall to the face of the trimmer, T. This distance, then, to the door will be the space available for our treads, or "going."

Now divide the width of staircase (6 ft.) into two equal parts, and on the centre line draw the *newels*, N, N, N. It is very important to bear in mind the fact that in *all* staircases there is *always* one riser *more* than tread, this being on account of the landing counting as one. This being the case, as there are twelve risers in the flight, there must necessarily be only *eleven* treads to deal with; we therefore divide the space from *centre to centre* of the *newels* into eleven equal spaces, as seen.

Now, there being four risers in the top flight, divide the space on plan (representing the "going") into three equal parts.

By projecting lines from the plan to meet corresponding lines in the elevation, we obtain the steps as seen and previously described. At a distance of 2 in. from the nosings draw a line parallel to them, and at a distance of 9 in. from this line draw another, which represents the width of string. Now draw the newels (which are 4 in. square), and at a height of 2 ft. 7 in. from the nose of steps draw a line representing the *top* of handrail; also draw the bottom edge of rail. Draw the rail on the landing at a height of 3 ft. 1 in., as seen. Now, by allowing about 4 in. above the strings and 1 in. each side of the rails, we obtain the necessary squares between which the newels are turned, as seen. It will be observed that there is a small piece of turning at the bottom of several of the newels, known as a *drop*. This is on account of the newels showing below the ceiling line. Now draw the skirtings, s, at their respective widths, and all that is necessary for our working drawing is accomplished.

Setting out Wall and Outside Strings.—Having completed the drawing, first measure the length necessary for the wall strings—that is, from the ground to the first landing—by laying the rule along the top edge of string-board, S B, as seen in Fig. 1 (sectional elevation), from *a* to *b*. This extra length beyond the newels is to allow for the *easements* to skirtings at top and bottom. Now take the length from the first to top landings. The length of outside strings can be taken from the *outside* of the newel at bottom to the one at top, always allowing a few inches to *play* with. The sizes for the newels can also be taken from the drawing. Having set out the pitch-board as before, apply it to the wall string at bottom, so that the edge marked *tread* on pitch-board may coincide with points *c* and *d* (Fig. 3). Then, by cutting the string off at this line, we at once obtain the pitch of stairs, *e f* being the angle between the line of steps and the horizontal plane. Now set out the spaces for treads and risers as before.

To set out the outside strings, commence by applying the pitch-board at the bottom of string as at Fig. 3, only that, instead of allowing the piece to run on, it may be cut off, as seen in *dotted* line, from *h* to *i*, this being for the tenon. The *dotted* line *k* is the *shoulder*, this line being drawn at a distance of 2 in. from, and *behind*, the first riser. The reason for this will be obvious when we remember that the going was taken from *centre* to *centre* of the newels, thus placing the risers starting and landing in the centre of each. The top of string will be set out as seen at Fig. 5, only that the shoulder, *c d*, will be 2 in. in *front* of last riser, *a b*. The tenons should be cut with the *shoulder* on the *inside* of strings, as at Fig. 6, and may be about $\frac{5}{8}$ in. in thickness.

Easements for Skirtings at Top and Bottom.—The easements are for the purpose of forming a nice curve between the strings and skirtings. They are occasionally allowed to form an angle at the point of intersection, but this does not look so well, and is not recommended.

At the bottom, a piece (*c g*, Fig. 3) must be glued on the string wide enough to make out 9 in.—the depth of skirting on ground floor. At the top no such piece is necessary, the string being worked off to meet the 7 in. skirting, as seen in Fig. 4.

Working and Fixing Easements.—To work the bottom easement, a piece of the *torus* moulding should be cut from the skirting (as *a b*, Fig. 7), and laid upon the string, marking its width as *g s* (Fig. 3), then the width of the skirting (9 in.) from *c* to *t*. Now draw a nice easement between the points and cut it out. Now with a *quirk router* (which may be purchased at any of the tool merchants advertising in WORK), work a quirk, or groove, at a distance from the edge equal to the width of torus; finish the moulding with chisels and small planes. The torus moulding at the top is worked independently of the string, and nailed on as at *a b* (Fig. 4), as also is the moulding down the edge of the string itself.

Depth of Trimmers.—As I have said before, it is very important that the depth of the trimmer joist should be known, as from this we obtain the square necessary for the bottom of newels. At Fig. 5 this will readily be seen, as if the square had not been long enough between the points *e* and *f*, the turned *drop* at bottom would have come above the plaster, P.

Return Flights.—Return flights are so called on account of their returning in an opposite direction to the bottom flight, as in Fig. 1.

Setting-out Newels.—To set out the newels successfully requires, in the novice, a deal of careful attention and some little practice, or on receiving his newels back from the turner he may find them utterly ruined, on account of his *squares* being in the wrong place; this is not said to discourage, but only to enforce his attention. To set out the bottom newel, first mortise it to receive the string as at Fig. 8, draw-boring it up to its shoulder. Now, from where the *housing* for the first step joins the newel (6 in. from bottom), measure up the distance equal to the height of handrail—in this case 2 ft. 7 in. (see Fig. 9). From this measure the thickness of rail *downwards* in a line at right angles to the bevel, as *a* to *c*, thus obtaining the position for mortise. It should have been observed that the *bevel* is taken from the pitch-board, as, of course, the rail is the same pitch as the stairs. Now mark 1 in. each side of the mortise, *a b*, thus obtaining the square necessary. As the patterns for newels, of course, are not always alike, the piece at top must be allowed for according to the design. Fig. 8 is a very good form of newel, and not very expensive.

The next newel will require a much longer square at the bottom, as it will take the two strings. The bottom string should be fitted and the step to landing marked (see L, Fig. 1) from this line. The next step on return flight should be measured upwards, and the top string also fitted. Now from this top step measure up the distance to top of rail, and set out square as before.

Newel No. 3 will be treated in the same manner, except that the bottom square will only require to be 12 in. from the floor level, allowing about 4 in. above at top and 3 in. for the drop at bottom.

This newel also must have a square left at the top, to allow for the rail on the landing,

which is 3 ft. 1 in. in height, and a small piece should be turned between, or the square will be long and ugly. Fig. 5 is an enlargement of this newel.

Position of Strings in Newels. — The strings are sometimes placed directly over each other in one vertical plane, but it is a much better plan to place them one each side of the *centre line* on newel. Fig. 10 shows them so placed. The bottom portion of newel shows at *a*, the string, C the cap, B baluster, M moulding, and H handrail. The upper part has the two strings, *a* and *b*, with half the rail at H shown.

The reason for this method being superior to the other lies in the ability to place half the rail on the return string, as shown in the Fig. It may here be remarked that the long rail at bottom only continues as far as the top or return string, and the half-rail then finishes down to the newel.

Caps for Balusters, etc.—As seen in Fig. 10, the strings, coming each side of the centre, throw the balusters on one side. To obviate this, a cap must be prepared to nail on the top edge of string, wide enough at top for balusters and at bottom for thickness of string, and a piece of moulding equal in thickness to the other string. This is shown enlarged in Fig. 11, B being the baluster, C the cap, M moulding, and S the string-board.

Newels on Landings.—These newels are placed at the angle of landing, to take the return rail, and are set out as seen at A, Fig. 1. There being only one square necessary at top causes the turning to be a good deal longer.

Height of Handrails.—The height of rails vary, but they must always be higher on the landings than on the stairs, or people may fall over.

Nosings.—Nosings are placed in the newels at top, half-way on the joist, and form the top step. This will be fully described in a future paper.

Balusters.—Balusters are used of various kinds, both square and turned, and range from 1 in. to 2 in. in thickness.

Sections of Handrails. — Handrails are made in a variety of forms, according to taste and class of stairs; but as this does not enter into our present study, we will leave it for a future paper.

Spandrels.—Spandrels are made in a number of ways, the one shown in Fig. 1 being of a very common order, being simply ¾ in. matchboard nailed in. S is the spandrel; C C C C a cupboard front made to receive a door, as by this means a very useful cupboard may be easily constructed.

Reference to Former Figures.—As the description of method for setting out a flight of stairs has now been described, students will be referred to former figures in all future examples—that is, as regards pitch-board, setting-out strings, etc.—or else we shall only repeat ourselves over and over again.

MEANS, MODES, AND METHODS.

TRANSPARENT CEMENT FOR MICROSCOPICAL PURPOSES.—The following recipe for forming a good transparent cement is said to be highly recommended:—Gum dammar, 5 drs.; gum mastic, 3 drs.; dried Canada balsam, 3 drs.; chloroform, 1 fluid oz.; spirit of turpentine, 1 fluid oz. Dissolve by shaking, then filter through filter-paper. To our readers who are following our various articles on microscope and telescope appliances this cement should be useful.

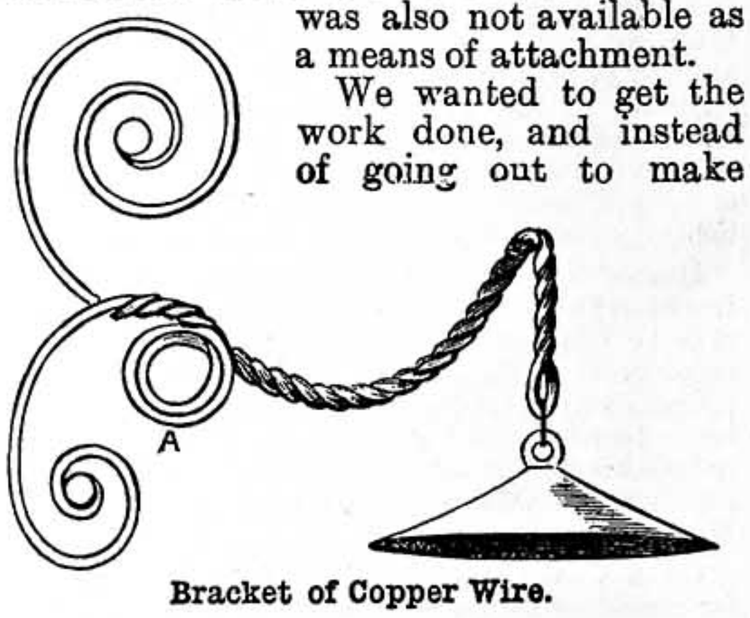
A CHEAP AND EASILY-MADE BRACKET TO SUPPORT A GLASS SMOKE CONSUMER.

BY H. S. GOLDSMITH.

THIS came into existence from one having a ceiling which threatened to come away if it was touched, and as paraffin lamps do smoke sometimes, we were compelled to find some other way of supporting the smoke consumer in its proper place.

As shown by the sketch, it was for a bracket lamp we had to arrange: one over a mantelshelf close to an overmantel, which was also not available as a means of attachment.

We wanted to get the work done, and instead of going out to make



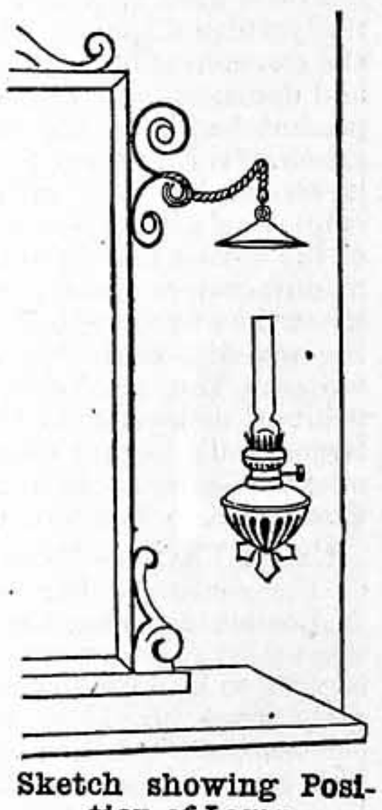
Bracket of Copper Wire.

inquiries here, there, and everywhere for something that would do, we set to work with pencil and paper and devised this article, which cost us nothing more than an hour's work.

The material, which we had by us, is 4 ft. of copper wire, rather less than ⅛ in. thick. It was first got quite straight, then doubled on itself, one end being 5 in. or 6 in. longer than the other. We next made the round loop (A) by turning both ends round a strong peg—an inch screw well driven into the wood-chopping-block answered very well. The loop was 10 in. to 12 in. from the end.

We next put an iron rod into the closed end, and twisted the wire up into a rope by merely rotating the rod; the two loose ends we twisted up our fingers.

We now took the screw out, and very carefully got the whole thing into form; the single loose ends were turned up into spirals, the double part into a graceful snake-like curve, this shape being necessary to get the consumer in its proper place right over the lamp chimney.



Sketch showing Position of Lamp.

A hook on the glass consumer passed through the loop on the end of the wire, which was formed by doubling it over at the commencement. We finished our work by blackleading it—just a rub or two with the stove-cleaning brush did it.

It is held in its place by a good strong brass-headed nail through the large loop, and by two small ones through the centre of each spiral.

We spent some time over the scrolls, and now that it is up in its place there is nothing of the makeshift about it. In small households it would prove very useful.

SCIENCE TO DATE.

Aluminium.—Some experiments made at Berlin with a view to test the applicability of aluminium for the construction of cooking utensils, etc., have proved unfavourable to the employment of this metal for this purpose. It dissolves rapidly, and in relatively considerable proportions. It is worthy of notice, however, that the metal is becoming cheaper every day.

Electrical Transmission of Power.—One of the features of the Frankfurt Electrical Exhibition was the transmission of power by electricity from Lauffen, on the Neckar, to Frankfurt, a distance of 110 miles. It is now reported that 113 horse-power taken from the river at Lauffen represented 81 horse-power at Frankfurt; so that, taking into account all possible sources of loss, the efficiency was 72½ per cent.

A Colourless Varnish.—We have tried, and can answer for, the following directions for a colourless varnish: Dissolve 2 oz. of bleached shellac in 1 pint of rectified alcohol; to this add 5 oz. of animal bone-black, which should first be heated, and then boil the mixture for about five minutes. Filter a small quantity of this through filtering paper, and if not colourless, add more bone-black and boil again. Run the mixture through silk and through filtering paper. When cool, it is ready for use.

An "Alpine Club" in South Russia.—An "Alpine Club" has been formed at Odessa with a view to exploring the mountains of the Crimea and affording facilities to tourists visiting this country.

Optical Measurement of High Temperatures.—M. Chatelier has made experiments to devise a method for measuring high temperatures by determining the intensity of the luminous radiations emitted by a pyrometer of platinum or clay. The results are satisfactory. The method is especially available for metallurgical operations.

Disappearance of a River.—The Vorskla, which fifteen years ago watered one of the most fertile districts in the province of Poltava, Russia, is now entirely choked up with sand. All that remains of the river are a few large pools.

NOTES FOR WORKERS.

ON a cold day about 40,000 tons of coal are consumed in the 700,000 houses in London; and this coal emits, from about 1,500,000 chimneys, 480 tons of sulphur. An effort is being made to get anthracite—a variety of coal which contains no sulphur and emits no smoke—generally used in London, and so abate the "fog nuisance." It is already largely used in Paris, Berlin, etc.

THE Chicago Exhibition buildings will be dedicated with suitable ceremonies on next October 12th, the 400th anniversary of the discovery of America by Columbus.

DR. NANSEN expects to leave Europe about January, 1893, for his expedition to the North Pole. A specially constructed vessel is nearly completed; its nett tonnage will be about 250, and it will accommodate 12 men. Provisions will be taken for six years, although the expedition may not be away for more than three or four.

IN repairing lamps, many find it difficult to get the old plaster out of the brass socket or collar. To do this, heat the collar and then plunge it into cold water, when the plaster will wash out quite easily.

AN Arlington gardener has introduced electric lights into his hothouses, with the result that he can raise a larger crop of lettuce or cucumbers in a shorter time than he could before.

MAGENTA is not a good stain for microscopic objects, as it stains diffusely, and the colour is not permanent. Hæmatoxylin and picro-carmine are far more useful.

IN October, 1885, Hell Gate or Flood Island, at the entrance of New York Harbour, was removed by a single blasting operation. It was nine acres in extent, and 282,000 lbs. of explosives were used, being fired by electricity.

FRICTION produces heat, and this heat produced is an exact measure of the work expended in overcoming the friction.

A FOOT-POUND is the unit of work; thus, if 10 lbs. be raised to a height of 3 ft., then 30 foot-pounds of work is done.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

SILVER AND ELECTRO TRADES.—The Sheffield silver and electro trades are dull. The trade in ivory and pearl is marked by increased prices, although the demand is not increasing.

HARDWARE TRADES.—In Rochdale district, trade is in a very bad state, and there is no sign of it improving, orders not coming in sufficiently fast to keep the men going; consequently, short time is the rule. In Sheffield, the makers of agricultural implements are well employed. Sheffield file-makers, as well as makers of crucible steel, are complaining of the severe competition at home and abroad, and their expectations of a busy spring trade have been unfulfilled.

TIMBER TRADE.—The Baltic Sale Rooms, where for many years the timber sales have been held, will in a few weeks know them no more, the rooms being required for other purposes. Messrs. Foy, Morgan & Co. have held their sales for some time past at the Cannon Street Hotel, and we understand that Messrs. Churchill & Sims will in future hold theirs at Winchester House, Old Broad Street. Quietude has been prevailing in the wood trade, and business will not revive until after the great May demonstration. The threatened strike for June 1st by the bricklayers and plasterers will tend to keep things back until arrangements have been made.

PLUMBING TRADE.—Plumbers have been pretty busy in the Liverpool district all winter, but trade is slackening, and there does not seem any prospect of its becoming brisk at present. Wages are 8½d. to 10d. per hour, according to ability. Joiners are earning 8d., but there are a good many seeking work.

FLANNEL TRADE.—This keeps in a satisfactory condition, most of the mills in the Rochdale district being busy. Manufacturers find the market in a better state than it has been for some time.

CUTLERY TRADE.—There is little alteration in the Sheffield cutlery trades. If anything, a falling-off is perceptible. Makers of bone, pearl, and ivory handles report that business is not improving. Matters have been altered for the better in Chili, Peru, and Uruguay; but the improvement in these directions is counterbalanced by the stagnation in the United States markets.

BUILDING TRADE.—In Rochdale and district this keeps in a prosperous state, scarcely a man belonging to any of the building trades being out of work, unless by his own fault. Our Birmingham correspondent writes:—The strike of bricklayers and labourers in the building trades seems no nearer a settlement; the masters still offer arbitration, which the men stubbornly refuse. As yet, no ill-effects are felt by the allied trades—carpenters, plumbers, painters, and glaziers.

ENGINEERING TRADE.—The condition of the Lancashire engineering trade remains much the same as it has continued of late, and a steady depression appears to be setting in all round. Locomotive builders report a fair amount of new work in hand, but no very encouraging prospects for the future; while machine tool makers, although here and there fairly busy, are, as a rule, getting very short of orders. Stationary engine builders are steadily quieting down, and, with few exceptions, the leading firms of machinists have few orders of any weight coming forward. The Barrow district continues to be the only locality in the county in which anything like activity exists. The iron trade continues very quiet; but as there is an almost complete cessation of production in the North of England, prices in some branches exhibit an upward tendency.

JEWELLERY TRADE.—In London there are signs of life, for a few orders are about, now that Easter is past. The termination of Lent, almost coinciding, as it does, with the end of a quarter, has put just a little liveliness into trade. About this time we expect to find a gradually increasing amount of work about, and so far the quantity of orders seems to be but little less than the average. We cannot expect anything like the season we were looking forward to, but still, it will be a fairly busy one in all probability.

CHEMICAL TRADE.—The chemical trade is rather dull. There is a falling-off in the export of most articles, though an increase for bleaching powder. Present prices are: Oxalic acid, 3⅛d. per lb.; soda ash, 48 to 58 per cent., £5 6s. 3d. to £6 7s. 6d. per ton; caustic soda, £10 10s. to £10 15s. for 70 per cent., £9 12s. 6d. for 60 per cent.; soda crystals, £3 10s. to £3 12s. 6d. per ton, f.o.b.; borax, 28s. 6d. to 29s. 6d. per cwt.; yellow prussiate of potash, 10½d. per lb.; bichromate of potash, 3¾d. per lb.; chlorate of potash, 7d. per lb.; chloride of ammonia, £33 to £35 per ton; bleaching powder, £7 5s. to £7 10s. per ton; sulphur, roll, £8, flour, £9 5s. per ton; copperas, 45s. per ton; blue vitriol, £14 15s. per ton; white lead, English, £29 per ton.

MASONRY TRADE.—At the quarterly meeting of the Aberdeen Operative Masons' and Stonecutters' Society the chairman explained that in a number of cases in which it was reported that journeymen were underpaid and too many apprentices were employed, complaints were lodged with the firms involved, with the result that the ground of complaint was at once removed. It was proposed and seconded, and, after considerable discussion, agreed to by a large majority, "That, in view of the number of our members who are annually out of employment, this society is of opinion that the number of journeymen is in excess of the requirements of the trade, and, in order to remedy to some extent such a state of affairs, the Standing Committee be instructed to use every endeavour to organise the masons of the different centres throughout the North with a view to limit the number of apprentices employed, and co-operate with this society in establishing an eight hours day in the granite trade."

DYERS' AND FINISHERS' TRADES.—A memorial from the Dressers', Dyers', and Finishers' Benevolent Society has been adopted for presentation to the employers of Manchester and district. The main proposals are: (1) That the maximum working hours be reduced to 56½ per week; (2) that hours so reduced be taken off the latter portion of the day; (3) that the said reduction come in operation on Monday, the 16th.

COAL TRADE.—The strike of Durham miners is far-reaching in its effects. The brass casters and smelters of Birmingham and district are nearly at a standstill for want of Durham coke, which, it is asserted, is pre-eminent for their purpose. Coke made of Midland coal is no good. Some are trying Welsh coke, but the supply is so indifferent and uncertain as to cause a vast amount of inconvenience. In Manchester and district, coal for trade purposes has lowered somewhat in price. Local colliery owners have to reduce their prices on account of the plentiful supply of Welsh coal at cheap rates. The price of house coal is firm.

COTTON TRADE.—A meeting of delegates from the Master Cotton Spinners' Federation and the Amalgamated Association of Operative Spinners has been held in Manchester with reference to the Stalybridge dispute. The matters considered were the assessment of compensation for alleged bad work and damages, and the question of discharging the present hands at the mill where the dispute has arisen. With regard to the first, it was agreed that it should be dealt with by arbitration; but the employers' section would not agree to the settlement of the second matter in the same way. The Burnley manufacturers have passed a resolution to work short time to the extent of three days per week in the weaving trade. Our Rochdale correspondent writes:—The much-talked-of lock-out is on the point of collapsing in this district, several of the largest mills having started work again, and all the others will be at it in a few days; so that what threatened to be a serious matter has passed away.

CYCLE TRADE.—From all home quarters we hear of the continued big trade of the manufacturers. In Boston, America, the dealers find the pneumatic tire to be the only tire saleable, and think the season is going to be a prodigious one for the trade. Large cycle firms intend to offer prizes to cyclists for performances done on their machines this season. This is apart from what is known as "makers' amateurism"—*i.e.*, amateur riders of repute employed by makers to attend race meetings and use their machines in competing for prizes.

SHEET METAL TRADES.—Trade has slightly looked up in various branches. This improvement is most apparent in season goods of galvanised iron, such as waterpots, baths, garden barrows, etc. Makers of japanned goods are likewise becoming busy in such lines as trunks, bonnet boxes, toilet ware, etc. Prices of sheet metals all round are very low, especially black sheets. Galvanised sheets are also remarkably cheap. Buyers at present have it all their own way.

POTTERY TRADE.—A great lock-out in the Staffordshire pottery trade is threatened, owing chiefly to difficulties which have arisen between two important firms of manufacturers and their workpeople. At a meeting of the Manufacturers' Association it was resolved that sixty-five manufacturers, employing 25,000 hands, should give their workpeople a month's notice to leave work until the disputed matters have been settled.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

I.—LETTER FROM A CORRESPONDENT.

Hobbyists' Emporiums.—J. W. R. (*East Liss*) writes:—"I have read with much pleasure your suggestions in WORK, No. 160, as to forming some means by which amateurs might dispose of their work, and should be glad if others would take the matter up. It seems to me that it would be a great boon to many readers of WORK and others. Could not some dépôt in town be formed, to which work might be sent for sale, a proper deduction being made as commission? An entrance fee also might be charged, the sender paying all expenses; and if not sold in a certain time, articles might still be given, with the sender's consent, to some sale of work. I think there are hundreds of people who would be glad to take the risk. Of course, the work might not bear comparison with professional, but there are many amateurs nowadays who turn out good work; and there are many ladies of limited incomes who would be glad of some such unobtrusive means of disposing of their handiwork. Such things as wood-carving, fretwork, macrame work and brackets for the same, Oxford frames, inlaying, etc.—indeed, it would be almost impossible to enumerate all the things which might be sent. I have been a subscriber to WORK from the first, and have often been struck with the ingenious suggestions of different correspondents. In many cases the proceeds would relieve absolute necessity; in others—to those who have not much spare cash, for instance—they might supply the means of purchasing tools and materials for further work. At any rate, it might create an interest in amateur workers of both sexes, even if the profits were not taken into consideration, and at the same time might, as you sensibly suggest, 'put him in touch with a market to which he might send his labour with some fair prospect of its finding a buying public at the makers' price.' I hope the matter will be taken up by other readers of WORK."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Incubator.—J. B. N. (*Lancashire*).—I presume you have not seen the "Incubator" article in No. 143. If not, order that, and also No. 149, from your bookseller, and I think you will find what you want. For a machine to take one hundred eggs, make your case about 18 in. by 12 in. (inside measurement). I do not think it will be necessary to alter the size of internal fittings, but you will need to allow for a larger heat supply, using for this purpose a lamp with a ten-line Kosmos burner. If you wish for any further details, write again.—LEGHORN.

Incubator.—W. W. (*Balham*).—(1) If you will again refer to the sketches on p. 610, No. 143, Vol. III., you will see by Fig. 11 (and also by description, if you read it carefully) that the disc, R D, is supported *over* the lamp flue by a tripod. (2) You will already have seen, in my reply to another correspondent, how regulator is to be fixed. (3) For the plunger cut a sound cork to slide easily in the tube, but mind it does not get wet. Turned ivory would be preferable, but more expensive. (4) For fittings, write to Mr. Stevens, whose advertisement appears in No. 149, "Sale and Exchange" column.—LEGHORN.

WORK MSS.—E. A. P. (*Cork*).—Contributions to the "Means, Modes, and Methods" column of WORK are not paid for, this column being open to, and for the benefit of, all readers of WORK. It is a pity you do not get your weekly copy of your local bookseller; and if you or others experience any difficulty in obtaining the publication, you have only to make this known to the publishers—Cassell & Co., London, E.C.

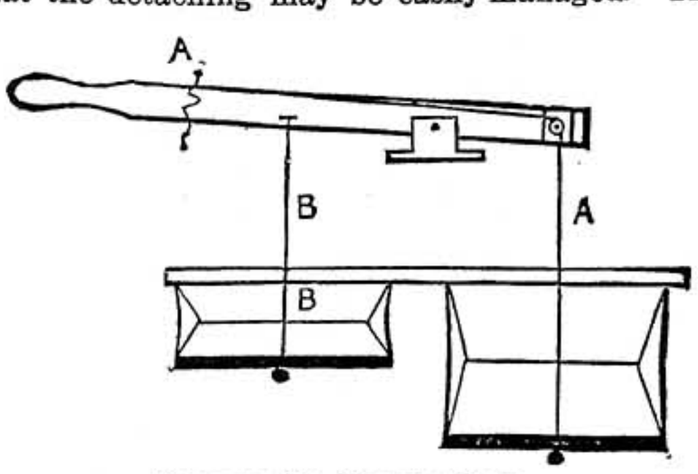
Guide to Letter Writing.—H. H. (*Burton-on-Trent*).—Messrs. Warne & Co., Bedford Street, Strand, London, W.C., publish one which is popular, and seems calculated to answer its desired end. Particulars with regard to it you will get from your bookseller.—S. W.

Accumulators.—H. McM. (*Bootle*).—Grids of lead, such as you propose, have been tried with only partial success, as a grid of perforated lead over the paste increases the internal resistance of the cell, and shields a portion of the active material from the direct chemical and electrical action necessary to ensure a full volume of current. If the plates are properly perforated, and the paste of red lead, or of litharge with sulphuric acid, is well forced into the perforations so as to form a firmly adherent coat, and this coat is allowed to become quite firm before placing the plates in the cell, there need be no fear of the paste dropping off, providing, of course, that the plates are subjected to fair usage. Knowing that the coating of lead paste is, at its best, friable, some care must be taken in handling the coated plates, so as to prevent the coat from being cracked by buckling or jolting. Plates are liable to injury in the cell from a too rapid charge and a rapid discharge or short-circuiting. I saw a set of plates a little while since that had been in daily use for fifteen months, and had not lost any paste, if we except a very thin film on the bottoms of the cells. The sample of powder enclosed in your letter was a good sample of litharge.—G. E. B.

Model Electric Lights.—P. A. B. (*Manchester*).—Articles on the above appeared in Nos. 76, 82, 89, 92, 94, 97, 99, 101, and 104 of WORK.—ED.

Electro-Motor.—G. H. B. (*Horsham*).—If you will address your four questions to Mr. Atkinson, he will reply to them in detail. The little motor described in that article is not suitable for a useful dynamo, and was not designed to be used for this purpose. If the vendor of the castings does not advertise in WORK, you must write him respecting their price and cost of carriage.—G. E. B.

Blower for Harmonium.—F. W. (*Dunstable*).—We do not see how it is possible to use both foot blowers and side lever on the same bellows without foot blowers "affecting the shaft," or, as an alternative, requiring the bellows feeders being detached from the lever. F. W. can, however, alter shaft so that the detaching may be easily managed. The



Blower for Harmonium.

accompanying sketch will give a way by which it may be done. Put a pulley in the lever, and lead a piece of catgut from feeder over pulley and along lever to any accessible part of handle, making fast to a hook or cleat provided for the purpose. Feeder (B) may be attached to the lever with a piece of catgut.—B. A. B.

Electric Belts.—J. C. E. (*Salop*).—I do not know of any maker of electric belts who manufactures them as described by me in No. 141, p. 589, but I agree with you that such belts are different to those generally supplied to purchasers.—G. E. B.

Cutting Gas Retort Carbon.—J. M. (*Kirkham*).—Use an old saw or piece of iron made in the form of a saw, and an abundance of wet silver sand or other sharp fine sand. Fix the carbon, and saw away at it, using plenty of elbow-grease, until sawn into the required rods or plates.—G. E. B.

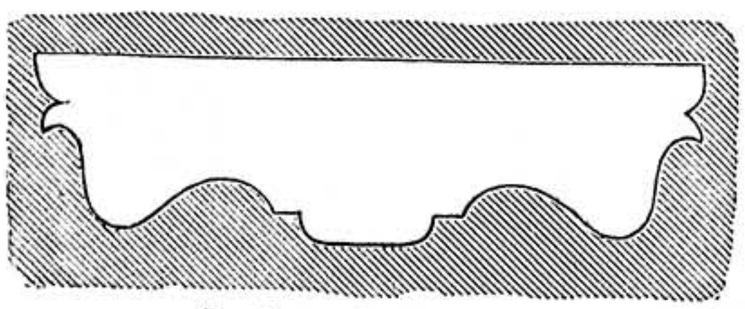
Quarter Horse-Power Engine, etc.—OLDHAM ENGINEER.—Articles on the "Quarter Horse-power Steam Engine" appeared in WORK, Nos. 106, 110, 121, 125, 131, 136, 141, 145, and 149; on "Knotting, Splicing, and Working Cordage," Nos. 105, 109, 113, 117, 120, 124, 127, 134, 139, 143, 147, and 150.

Lacquering.—F. S. (*Dover*).—Yes; you are quite right as to the address of the firm. See also reply to H. J. (*Oxford*) in this number. Sample bottle, 1s.—R. A.

Art Designs.—SOUTH KENSINGTON.—Design both for interior and exterior application will in future find much more space in WORK—as you will have seen from Vol. IV., No. 157. Arrangements have been made with several trained art workers to give us priority of designs, suitable for domestic and general application.

Labour and Trade News and Items.—FOREMAN.—Yes, information of this nature we have always regarded as useful to readers of WORK, and shall be glad to give insertion, in some suitable column of the paper, to any properly authenticated news of this kind which you or any responsible correspondent may send. Address the Editor of WORK, c/o Cassell & Co., London, E.C.

Duchesse Table.—G. C. (*Woolwich*).—As you seem to need many constructive details in reference to the above, I considered it preferable to omit a design, etc., in "Shop," and to draw the attention of my brother contributors to the following plan of the article you need, in the hope that one of them



Duchesse Table Plan.

may treat the subject fully in the body of WORK. I prefer to restrict myself to novelties; otherwise, I should have given more attention to this query; but my time is so fully occupied in devising new articles that I should not have felt "at home" in treating the article mentioned above.—J. S.

Optical Lantern.—W. H. (*Failsworth*).—All parts for lanterns you will obtain of Caplatzi, Chenies Street, W.C., who advertises in WORK.

Boys' Carpentry.—JACK PLANE.—Some pages of carpentry for boys will appear in Volume IV. of WORK, beginning with No. 157. The first paper was on Rabbit Huches, and how to make them.

Bookcase.—A. H. A. (*No Address*).—I advise you to look through the indexes to WORK for Vols. II. and III. (1d. each), wherein you will find noted so many particulars and designs relating to bookcases as preclude the possibility of detailing the several numbers containing them here. Of course, if you cannot then suit yourself, write again, and I will help you.—J. S.

Ivory Scale.—CONSTANT READER.—There are a thousand and one ways of rendering your scale legible by means of some black substance—black wax, soot from a piece of smoked tin, pencil dust, etc. The only point which need trouble you is in clearing off of all superfluous stuff, leaving only the lines black. A black enamel is preferable, as when dry it would not be liable to brush out. My own scale has become black in the lines from no other cause than that of constant use for the past few years.—J. S.

Tinmen's Tools.—W. J. H. (*Penzance*).—I have much pleasure in replying to your queries. (1) For tin plates, try Godwin, Warren, Fry & Co., Bristol; Peate, Chattock & Co., Thames Street, London, E.C.; or A. & H. Farwig, Thames Street, London, E.C. (2) Cheap tin goods: Ponder & Baker, Featherstone Street, London; Harding & Son, Long Lane, Borough, London. (3) I would not buy a grooving machine until I found the work sufficient for one; then it is a great time-saver. (4) Order small, medium, and large bick-irons; cast-iron will do for the largest size. (5) By all means have a dripping-pan swage: it is indispensable for cheap dishes. (6) Get a medium-size horse and a full set of heads; you will find a use for all. (7) Follies are very useful indeed for punching the holes for riveting tea-kettles and tea-bottle handles, and similar work. (8) The oval handle former will turn ¼ in., *but not thicker*, very well. I should advise you to try and cultivate a good class of trade. Make your goods well and of good stuff, and they will soon get a name. There is so much "jerry" work about in tinware now, especially in country towns, that it is really difficult to get a strong, well-made article without having to bespeak it, and then it costs nearly double what it ought to. If you have a prospect of being fairly well employed, I should try and get a steady lad as apprentice. You will find him very useful making small work, and assisting you in any out-of-doors work that you may have. I do not know that I can add anything more, except to say that I shall at any time be willing to help you through the columns of WORK. You should read WORK regularly.—R. A.

Lacquering.—H. J. (*Oxford*).—It is somewhat difficult to say why you have failed in lacquering your brass furniture, as there may be several reasons for it. You should not dip the articles, but, after they are finished ready for lacquering, place them in the oven, or on a hot plate, till they are just hot enough to be bearable by the back of the hand. They must not go much beyond this, or the lacquer will burn. Try the under part first, and if the lacquer frizzles and turns dark red, it is too hot, and you must wait a minute till it cools a bit. You should use a soft camel-hair brush, and not have too much on it at a time. Give decided strokes with the brush, and do not go over any part twice till you have coated it once all over. You can lacquer cold and put in oven, but it is not quite so good. If you have any difficulty, I strongly advise you to try the substitute for lacquer sold by the Fredk. Crane Chemical Company. It can be used cold, and I consider it superior to the ordinary kind. It can be had in a variety of shades; and the firm will, I believe, send a sample bottle for 1s.—R. A.

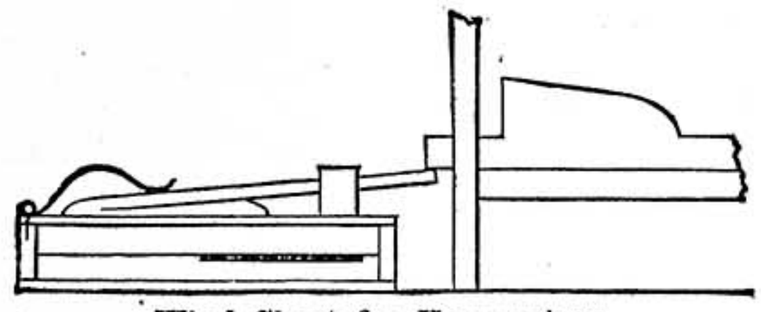
Lacquering Bedstead.—J. L. (*Harleston*).—See reply to H. J. (*Oxford*) in this number.—R. A.

Cycle Matters.—HOLBORN.—(1) The numbers of WORK in which cycle making appeared are in Vol. III. I am unable to give the numbers, as part of my WORKS are lent out. The Editor gave a list of the numbers to a correspondent. You should write to the Editor. (2) Weldless steel tube may be had of most cycle houses. For long lengths, write Herbert & Hubbard, Coventry, or Credenda Steel Tube Works, Birmingham. For short lengths cut for a cycle frame, write St. George's Cycle Company, Upper Street, Islington; Brown Bros., 7, Great Eastern Street, London; Thos. Smith & Son, Saltley, Birmingham. The price for lengths cut are about per foot: 1⅛ in., 1s. 8d.; 1 in., 1s. 4d.; ⅞ in., 1s. 2d.; ¾ in., 1s.; ⅝ in., 10½d.; ½ in., 9d. (3) The long wheel base, as applied to a safety bicycle, means a greater distance between the wheels, say, from 12 in. to about 15 in. or 16 in. 1st, it has this advantage, namely, the steering wheel is sufficiently in advance of the pedal shaft to make it safe from touching the toes when pedalling round a corner. 2nd, It is said to make the machine steer steadier. 3rd, It throws less weight on the steering wheel, and, consequently, more on the rear wheel. 4th, It has this disadvantage: that as the steering post is a greater distance from the centre of seat, if the handles are not extended further back to make up the difference, then the rider has to stoop further forward to reach them, and looks like a monkey on all fours. This is a fault that already exists in a good many otherwise good machines.—A. S. P.

Model Hot-Air Engine.—APPRENTICE.—The pressure and vacuum in the model hot-air engine on p. 717 is so small, and the power developed so little, that packing would create too much friction. I should trust to a good fit made by grinding out the bits of tube for the cylinder and plunger; then add a little grease, which melts with the heat. It is more important to avoid friction than to stop all leakage. Very likely there is *a little*, but you cannot see it as with steam; also, it is not of much consequence.—F. A. M.

Mercurial Column.—J. H. (*Mile End*).—You will obtain full information on this subject by writing to Messrs. Negretti & Co., Holborn Circus. If the gauges you wish to test are for high pressures, you will find some difficulty in using the mercurial column, as, putting it in round numbers, fifteen pounds per square in. is balanced by 30 in. of mercury.—F. C.

Pedal Chest to Harmonium.—S. G. V. (*Battersea*).—Make a small wind chest, in length equal to full width of the pedals you have. The top of the wind chest will carry levers and pallets, at the same time forming the pan for reeds; ordinary springs will do, and reeds of broad description can be had. If S. G. V. is a wood-worker, let him try wood reeds, mortising an opening in a piece of ⅛ in. beech, and fitting reeds of ⅛ in. rosewood or box. The trouble may be considerable, but the tone is beauti-



Wind Chest for Harmonium.

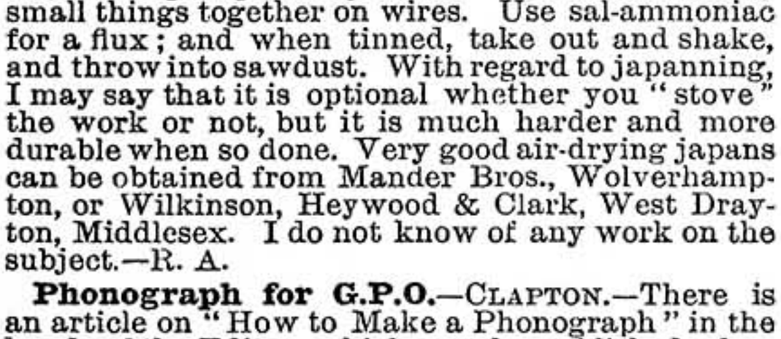
ful: like a euphonium in quality. The accompanying section will afford an idea of how the pedal action may be made. Without seeing the harmonium, it is impossible to tell the best way to connect the wind trunk to bellows and chest, or the best place to put it. If more than one set of reeds are required, some trouble will arise in stop-action, but if only one set of reeds, a valve to control wind supply is all that is needed.—B. A. B.

Tinning Iron Ears, etc.—TINNER.—To tin small articles of wrought iron such as you mention, you need a "bath"—that is, an iron receptacle for some quantity (according to the size of your work) of molten tin. The goods to be tinned are pickled in hot acids—a mixture of hydrochloric and sulphuric acids and water of equal parts will do very well. The hotter it is the quicker the articles will be ready for tinning. After pickling, dip the articles in a tub of killed spirits of salts without water added, and place them very slowly in the bath of tin, holding large things with tongs, and stringing small things together on wires. Use sal-ammoniac for a flux; and when tinned, take out and shake, and throw into sawdust. With regard to japanning, I may say that it is optional whether you "stove" the work or not, but it is much harder and more durable when so done. Very good air-drying japans can be obtained from Mander Bros., Wolverhampton, or Wilkinson, Heywood & Clark, West Drayton, Middlesex. I do not know of any work on the subject.—R. A.

Phonograph for G.P.O.—CLAPTON.—There is an article on "How to Make a Phonograph" in the hands of the Editor, which may be published when space permits.—W. D.

Tissue Paper.—BRASS.—Write to D. F. Taylor & Co., New Hall Works, George Street, Birmingham. They may be able to supply you with what you want.—W. D.

Stone Arch.—YOUNG EBOR.—Draw a section of the arch, and divide it into the number of stones in the arch, as at A. Below this draw the plan as at B, setting off the thickness of the soffit. The first stone is worked as at D, the face mould of the lower bed being the same curve as the plan. Work two drafts, *x*, *y*, square from the under bed, and apply two curved rules on these drafts, in the position



Stone Arch Plan.

shown, the curve of these rules being the same as the plan, and work the face to this curve. To find the face mould of the second joint, *o p*, divide it into four or more equal parts, and draw the lines 1, 2, 3, 4, 5, at right angles to the springing line to the curve of the plan; then draw the line in a parallel to the springing line. Draw perpendiculars at right angles to the joint line from the ends of the lines 1, 2, 3, 4, 5, and mark these to the lengths of the lines from *m n* to the curve of the plan. A curved line drawn through these points will give the curve of the face of the first joint. The remaining joints are found in the same manner. To find

the soffit mould, draw lines *r*, *s*, *t*, *u*, from the joints of the arch at right angles to the springing line and through the plan; then draw perpendiculars at right angles from the springing lines, as shown at C, the distance between these being equal to the length of the soffit of each arch stone. Then draw lines parallel to the springing line from the points where the lines *r*, *s*, *t*, *u* cut the plan, and draw curved lines through the points in the perpendiculars where these parallel lines cut them, which will give the soffit moulds of each stone. The moulds for half the arch only need be got out. There is another method described in P. Nicholson's "Practical Masonry and Stone Cutting," published by Batsford, High Holborn.—M.

Designs for Cottages.—T. R. H. (*Birmingham*), P. S. (*London*), O. W. O. (*East Dulwich*).—I cannot tell you what scale the designs for cottages in No. 150 are reproduced to. Size of rooms: Ground floor—kitchen, D, 14 ft. × 10 ft.; scullery, E, 8 ft. × 10 ft.; parlour, C, 12 ft. × 10 ft. Chamber floor—Bedroom, O over D, 14 ft. × 10 ft.; bedroom, O over E, 8 ft. × 10 ft.; bedroom, O over C, 12 ft. × 10 ft.—W. B.

Timber Buildings.—O. W. O. (*East Dulwich*).—The only books I can recommend you on timber buildings are Nicholson's "Carpenter and Joiner," Rivington's "Building Constructions" (Vols. I. and II., price 8s. 6d. each nett), or Seddon's "Builders and Building Work," price 12s. 6d. nett. All these books are thoroughly practical ones.—W. B.

Distance between Railway Carriages.—RINBY.—Your question calls for several answers, each applying to the special composition of the train. On suburban and local lines trains are run with carriages having buffers at one end only, the contiguous end of the next carriage being fitted with a spherically recessed block. The vehicles in this case are connected by links and pins. The distance between the carriages can thus be restricted to 18 in. The distance between the carriages coupled by the ordinary links will, in some cases, reach 4 ft., and the play of the buffers is in proportion. The actual length of the buffer rods varies with the type of buffer used; if they are controlled by leaf springs in the under frame of the carriage, the rods will usually extend into the framing for about one-quarter of its length. If spiral springs are used abutting against the inside transom of the frame, the rods will be shorter. If the buffers are self-contained, as in the "Brown" or "Turton" makes, the length of each beyond the buffer-board of the vehicle will be about 2 ft. These buffers are controlled by volute springs, which are coiled about the tubular trunk of the buffer. If you wish to get some idea of the number of buffers, central, side, and combined with couplings, you should run over to the Leeds Public Library, and look through the Patent Specifications.—F. C.

III.—Questions Submitted to Readers.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Type Ribbons.—J. B. (*Jubbulpore, C.P., East India*) writes:—"I shall feel much obliged if any reader could inform me how to make inking ribbons for a typewriter in indelible black and coloured inks."

Aniline Colours.—AMATEUR CHEMIST writes:—"I want to know the chemical names and synonyms of the black, blue, magenta, violet, etc., aniline dyes sold in packets. Also, if there is more than one compound giving same colour, the means of distinguishing same."

Kites.—H. N. (*Ipswich*) writes:—"I should like to know how to make parachutes that may be sent into the air like kites. Also, how can I make ornamental kites resembling birds and animals; or where can such information be obtained?"

Paste.—H. C. (*Old Charlton*) writes:—"Can you or any of your very numerous readers inform me how to make a paste which will *not* dry (say, within a fortnight), and which contains no grease? Such a paste is made, I know, but I have been, up to now, unable to obtain the recipe, or even the compound itself."

Enamel on Slate.—H. A. H. (*Tunbridge*) writes:—"Can any reader tell me where to purchase enamelled slate in small pieces suitable for switch or fuse bases, or give particulars for enamelling slate for the same purpose?"

Pinhole Photography.—H. A. H. (*Tunbridge*) writes:—"Will any camera do to take views by above method?"

Match Brimstone.—T. R. (*No Address*) writes:—"Will any reader tell me how to mix the liquid for dipping, and what are the ingredients? Is the brimstone used hot or cold?"

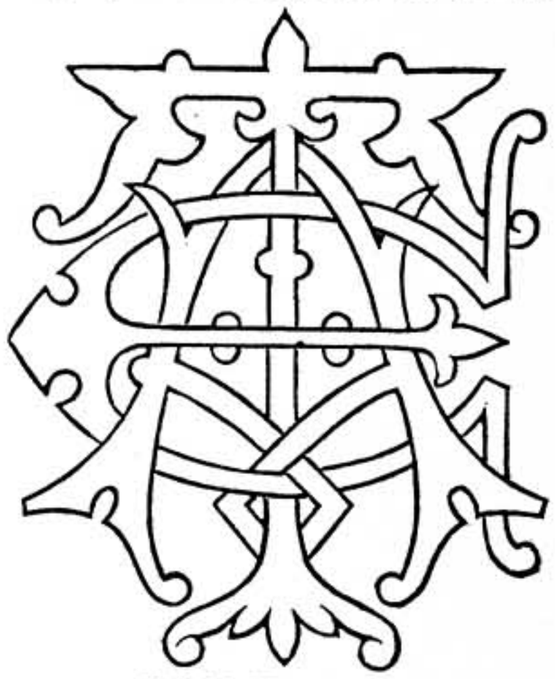
Surveying.—C. J. T. (*Devonport*) would feel obliged for the name of some cheap but reliable book on Surveying.

IV.—Questions Answered by Correspondents.

Copies of Photographs.—R. A. R. B. (*Oxford*) writes to RECTILINEAR (see No. 156, page 830):—"You must erect the photograph at such an angle to the light that no light is reflected from its surface into the lens. Then take the photograph, giving rather a long exposure. When developing, use a good deal of bromide and not very much ammonia, and bring the picture out very slowly, so that the result may be a dense negative, with as much contrast as you can get from the print. An isochromatic plate would be the best, but they require more careful treatment than the ordinary brands."

Musical Glasses.—TEACHER OF THE ZITHER writes, in reply to J. R. S. (*Liverpool*) (see WORK, No. 159):—"No solution is required; all that is necessary is to wash the hands clean from *grease*. A good rub with pumice-stone, and afterwards a wipe with a cut lemon, will ensure a clear and brilliant tone—always supposing that your *glasses* are also free from greasiness. Instead of the finger-tips, some performers prefer a pad, which may readily be made by straining a small piece of wash-leather over a small cork bung, the leather to be freed from grease and acidulated in precisely the same way as mentioned above for the fingers. A much more lively *tempo* may be achieved by the use of the pad than is possible with the fingers, as the surface is so much greater."

A. E. T. Monogram.—R. D. T. (*Marylebone*) writes:—"I notice our respected correspondent, SHAMROCK (an Emerald lad) asks for 'A. E. T.' monogram (see No. 156, page 830). I have sent herewith a design which may suit our Emerald lad's purpose. The design is a little larger than would be required for the shield, but SHAMROCK can reduce it to size required."



Shield Monogram.

Lucifer Match Making.—A. B. C. (*Darlington*) writes to ANXIOUS INQUIRER (see No. 150, page 733):—"The ingredients are nitre, charcoal, and sulphur, the proportions of which vary in different factories. The sulphur is commonly in the smallest quantity, and the nitre in the largest. Some take but one part of sulphur to seven of nitre; others, three or four of nitre to one of sulphur and one of charcoal; others, two parts of charcoal to one of sulphur. There are differences also in the choice of charcoal and the sulphur, and the purity of the nitre. It is not the sulphur in the compound that first takes fire, but the charcoal. You can mix sulphur and nitre in as many different proportions as you like, but none of the mixtures will take fire from a spark without the addition of some animal or vegetable inflammable matter."

Coffin Plates.—GUGLIELMUS writes to H. E. L. (*Stockton*) (see No. 155, page 814):—"Get some quick-drying japanners' gold size, and with a camel-hair or sable writer (crow size) write the name, etc., after the following styles:

Patterns for Coffin Plates.

When sufficiently tacky—which it should be almost as soon as written, if you do not put the size on too thick—rub on a little *best* gold bronze with a hare's foot, carefully dusting off the surplus bronze with a flat camel-hair brush. This makes a very effective plate, and has, besides, the merit of drying very quickly, which is of much importance. Care must be taken, while writing, to keep a piece of paper between the hand and the plate, as the slightest moisture causes the bronze to adhere. Of course, it is easily rubbed off, but the part so rubbed gets polished, thus destroying the dead surface of the plate. The above method is suitable either for black or white plates. The appearance of the writing on a black plate may be considerably enhanced by shading the letters with the gold size."

Catgut.—H. M. H. (*Cambridge*) writes:—"In reply to CANOE'S inquiry *re* 'Catgut for Angling Purposes' (see No. 157, page 14), I should advise him to get 'Keene's Guide to the Manufacture of Fishing Tackle.' I quote the following from the above-mentioned work, as it may interest other readers as well as CANOE: 'Silkworm gut is manufactured chiefly at Murcia, in the south of Spain. . . . About the beginning of May, the silkworm is taken and plunged into hot vinegar, and, after remaining there for a few hours, the workmen slough off the body from the intestine. The latter is then stretched out, and each end is wound round a pin, and so left to dry. These threads are then gathered together (all sizes are mixed), and in a few days are ready for sale. The gut is sold in this state by the pound weight, and is purchased by the gut *manufacturers*. The first process to which it is subjected is that of being put in a bath of soap and soda, when the outer skin or scale comes off. It is then laid on rods, and hung up in a room to dry, and thereafter placed in an oven for the purpose of bleaching. After this, it is given out to girls, each of whom, taking each single fibre, puts one end between the teeth, holds the other end with the hand, and rubs it (the gut) with a wash-leather. She is paid so much per thousand strands. Next day she sorts out the various lengths and thicknesses of gut. She then again rubs each strand with the wash-leather, and then the gut is passed on to men, who tie it up in bundles of one hundred of each length and thickness, and it is ready for sale.' Mr. Keene says he got this information from Mr. Ramsbottom, Great Market Street, Manchester, who annually publishes a 'Gut Report.' He also quotes from this 'Gut Report' the prices of gut (in 1884-5), which vary from 2d. per hundred lengths to 50s. per hundred, according to quality, length, etc. etc."

Picture-Frame Making.—E. B. (*No Address*) writes to SENTINEL (see No. 159, page 46):—"I have had over twenty years' experience in frame-cutting, and I can safely and truly say that the best way is to cut them with the aid of a mitre block, and then to shoot them with a keen-edged plane. It beats all the machines that ever were invented; and as for cramps, while they are screwing one on I can get the whole frame together, and every corner glued and sprigged. I should not be able to get through one quarter of the amount of work if I had to bother with cramps."

Fretwork.—J. Y. (*Woolwich*) writes, in answer to W. M. (*Brixton Hill*) (see No. 146, page 154):—"If he will publish his address in WORK, I will send him one of Skinner's catalogues, as I have one to spare."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—C. W. S. (*Washington, D.C.*); J. W. R. (*Liss*); F. T. (*Porthill*); J. R. (*Dorchester*); W. L. (*Leith*); J. H. C. (*Halifax*); J. H. K. (*Hollinwood*); R. N. (*Grays*); W. H. (*Bradford*); J. T. (*Biggleswade*); J. B. R. (*Stourbridge*); S. P. (*Bromsgrove*); LEARNER; AMATEUR FRETWORKER; T. W. E. (*Bournemouth*); A. P. B. (*Walthamstow*); S. K. (*Leytonstone*); T. A. T. (*Dublin*); AMATEUR CHEMIST; J. W. (*Dublin*); A. W. (*Manchester*); APPRENTICE LAD; A. R. (*Falkirk*); W. W. (*Sheffield*); INCUBATOR; H. G. (*Leith*); J. H. G. (*Birmingham*); BUTCHER; T. M. (*Torquay*); W. B. (*Honiton*); J. W. (*Chorley*); CLAUDIUS; TINKER; NOVELTY MAD; BONÂ FIDE; J. McC. (*Lochwinnoch*).

NOTICE TO READERS.

Next week's issue of WORK—*i.e.*, No. 165—will contain the Second Article of the Series on "Design and Decoration of all Ages." The subject of the article and illustrations will be EGYPTIAN ORNAMENT AND DESIGN.—ED.

SALE AND EXCHANGE.

Victor Cycle Co., Grimsby, sell Mail-cart Wheels and Parts. [4 R

Cycle Fittings, mail-cart wheels and shafts, mitre-cutting machines and cramps.—WALKER BROS., Wellington Road, Leeds. [3 R

Buyers of Gas or Steam Engines, Machinery, and Tools, should call at Britannia Co., 100, Houndsditch, London, or send 2d. for the Tool and Machinery Register, containing 4,000 lots wanted and for sale. Address—REGISTER, Britannia Co., Colchester. [8 R

Caplatzi's Matchless Technical Collections embrace most things electrical, optical, mechanical, chemical, photographic, models, materials. Catalogues, 2d.—Chenies Street, Bedford Square. [9 R

The Climax Screw-chasing Lathe Attachment for 3 to 6 in. foot lathes. Enables a novice to cut perfectly true threads of any pitch from 8 to 30 per inch; seen working. Price 57s. 6d.—DRESSER, Swan Cycle Works, Lewis Grove, Lewisham, S.E. [11 R

Lettering and Sign-Writing made Easy.—Also full-size diagrams for marking out eight alphabets, only 1s.—F. COULTHARD, Darlington Street, Bath. 100 Decorators' Stencils (60 large sheets), 2s. 6d.

100 Fretwork Designs (new), 100 Carving, 100 Repoussé, 30 Fret Brackets, 100 Sign Writer's Stencils (all full size), 300 Turning, 400 Small Stencils. Each packet, 1s.; postage free.—F. COULTHARD, Darlington Street, Bath. [1 S

Picture Moulds.—15 to 25 per cent. saved. Send for wholesale list, one stamp.—DENT'S, Importers, Tamworth. [12 R

The Model Typewriter, 5s. 6d. Specimen of writing, one stamp.—WALTON, 9, Queen Anne Street, Stoke, Staffs. [16 R

Wanted.—WORK, Numbers 3, 6, 22, 42, 107, 108; "Amateur Mechanics," Vol. I., bound or numbers; Northcott's "Lathe Turning."—Address, R. TANNER, Portway House, Frome. [2 S

Carpenter's Bench for sale, cheap; also Goodall lathe, with fretsaw attachment and tools. Seen by appointment.—ROBINSON, 12, Sutton St., Commercial Rd. [3 S